RAILWAY AND DOCK WORKS.*

In the construction of a railway or dock a large amount of pile-driving is frequently necessary, and the manner of sinking piles has been much considered by engineers, for the purpose of obtaining rapidity and economy in executing their works. For some purposes, where piles were formerly used, cylinders are now sunk, and the manner of sinking them and their form and material have been much studied. For fine sands, such as were met with in piling for the Morecambe Bay viaducts, and the promenade pier in this town, I used a disc-pile, lowered into the sand by its own weight, as fast as the sand was removed from under the disc by a jet of water forced through a tube opening at the foot of the pile—a plan which has been applied by others elsewhere, and notably at Calais harbor-works recently, where a considerable saving has been effected by its use in sinking piles for the repair of the western jetty. At Morecambe Bay force-pumps were used, worked by a 2-horse steam engine; here, at Southport, advantage was taken of the pressure on the town mains. At Morecambe the cost of sinking was 2s. 6d. per foot, and at Southport only 4½d., an economy due to the use of the town water. At Southport twelve piles were repeatedly put down in a tide; at Morecambe the average was scarcely two in a tide.

For hard gravel, shale, or soft rock, such as is met with in the Mersey, I adopted a corkscrew form. Abroad, notably in Brazil, where the deposits are mostly alluvial, the ordinary bladed screw pile was used in one case for a bridge of ten spans, in 35 ft. to 40 ft. of water, with perfect success. In the Solway Viaduct, more than a mile long, it was originally intended to use the screw pile, but after getting through a depth of about 4 ft. of sand, it was found that there was such an exceedingly hard stratum of gravel, bound with stiff clay underneath, that the screws would not enter, and a round-pointed pile was substituted. I have used metal piles instead of cylinders, on account of the greater ease and economy with which they are put in place. In the case of the Eau Brink Viaduct, near Lynn, the span was 111 ft., the screw of the pile 3 ft. 3 in. diameter, and the pile 18 in. in diameter. Five piles were placed under each girder, and as the metal in these was equal to a cylinder 4 ft. 4 in. diameter, three times the bearing surface was obtained with the same weight of metal. The process of screwing is much simpler than that of sinking cylinders by the pneumatic process, and the whole operation is handier and more economical, wherever it can be adopted.

A great revolution in driving timber piles was effected by Mr. Nasmyth, who adopted the principle of his steam hammer to the purpose. The Nasmyth pile driver was first employed at an extension of the Devonport Docks, where a very large number of piles had to be used. At the first trial it did in four and a half minutes the work which by manual labor could only be done in twelve hours, and was perfectly successful from the first moment of trial. The Nasmyth pile-drivers generally in use weigh about 24 tons, the boiler weighs 76 cwt., the hammer weighs about 30 cwt., and delivers a blow every second on the head and shoulders of the pile, driving it down in ordinary soil from 5 ft. to 10 ft. per minute. A small engine moves the machine on a tramway, and three men manage the whole apparatus.

Iron cylinders for foundations were first used by Mr. Redman, on the Thames, at Gravesend, for the construction of the Terrace Pier in 1842, and they have since been largely employed all over the world. Many improvements have been made in the methods of sinking cylinders since their first introduction, when they were sunk into the yielding soil by pressure from above. The first practical application of compressed air to the sinking of cylinders appears to have been made in 1839, at Chalons, where it occurred to the engineer to cover over the top of the cylinder, and by the pressure of the air to drive out the water, and admit the workmen inside to remove the earth, and gradually to allow the cylinder to sink into its place. Lord Dundonald had previously patented the same system in this country, where it was first applied in constructing Rochester Bridge.

Several mechanical contrivances, more or less perfect in their operation, have been used for removing the soil inside the cylinders, to assist in lowering them into place. Mr. Milroy, Mr. Bradford Leslie, and others, have designed and used these mechanical aids with much success on the Portpatrick railway bridge across Loch Ken, at the Gorai bridge in India, and on the Caledonian Railway viaduct over the Clyde, and elsewhere. By their means considerable speed has been obtained in sinking cylinders in different circumstances, and where the employment of the atmospheric system would probably have been impracticable or unusally expensive.

Sir William Fairbairn attributes the suggestion of caissons to General Sir Samuel Betham, in 1798; and the ordinary floating caisson, to which the suggestion applied, has been very extensively used. In the construction of the Keyham Docks, Sir William applied a new form of caisson, to obviate difficulties created by the great width of the dock entrance and the depth of the basin, and to save the time lost in pumping out the old form of caisson. The new caisson was designed by Mr. Scamp, deputy director of the Admiralty Works. This caisson had a rectangular section, and consisted of six horizontal divisions or counterparts, of which two at the bottom formed the air chamber intended to float the caisson a few inches above the sill, so that it might be drawn into a recess out of the way of passing vessels. The next compartments were open to each other, and had a sluice valve on each side to admit water as ballast, to retain the structure in equilibrium, and to balance its floating power. The upper or sixth compartment formed a tank, capable of containing 70 tons of water, supplied from the main by a hose pipe, and was used for sinking the caisson into its place.

A few years later (1858) another form of caisson on a new plan was adopted in the formation of the Victoria Docks, London, to act instead of a cofferdam, which in the circumstances would have been costly, and have caused loss of time in construction.

This caisson, which was made of wrought-iron plates, was rectangular in the side elevation, the heel-posts being vertical, and shaped like those of gates, so as to fit into a hollow quoin, as into a kind of rebate. Its height was 31 ft., and its breadth 80 ft. Its curvature was not so great as that of the gates, having a rise, or versed sine, of only 8 ft.

Caissons which slide into a cut in the wall of the entrances at right angles with the waterway have also been used successfully. Their chief advantage is that they can be moved in less time than floating caissons.

There has been some controversy as to the relative advantage of caissons and gates for closing the entrance to docks. The former seem to be in favor in the Government docks; and at the Portsmouth Dockyard extension caissions were exclusively employed. Where a road has been provided for, probably a caisson is not more expensive than a pair of gates and a swing-bridge; but it cannot be so easy or so quick to handle, especially since the introduction of hydraulic machinery for opening and closing dock gates.

One of the most important operations in connection with shipping is the repairing, cleaning and painting of ships. For this purpose graving docks, from which the water was removed after the vessel had entered, were and continue to be mostly employed. But during the lifting of the tubes of the Britannia Bridge into place with what were then called hydraulic presses, it occurred to Mr. Edwin Clark that similar means might be used to lift a vessel out of the water and place it in a position to be dealt with similarly to a construction on dry land. Floating docks consisting of pontoons which lifted the vessel out of the water have been used in this country, and more extensively in America, for this purpose; and at San Francisco and Philadelphia a dock was constructed of pontoons in sections called "camels," any number of which might be used according to the size of the vessel to be docked. Mr. Clark's plan is quite different from these. His hydraulic dock consists of a number of columns arranged in two parallel rows, in which columns are placed the hydraulic lifting power. Between these two rows of columns extends a frame or cradle, over which the ship is drawn in the water. When the ship is in position the hydraulic lifts are set to work, and they raise the cradle first to the bottom of the ship, which, being properly secured, is then lifted with the cradle clear of the water. There is no difficulty whatever in the management of this form of dock, and it has been perfectly successful; its chief recommendation being that any area of shallow water can be made available for docking large vessels, and that it is especially valuable in tideless seas.

Among the many mechanical applicances for saving labor on railways and docks, the machinery for shipping coal is remarkable; the bulk, weight, and low price of coal render every item of saving in transport relatively important. It is commercially important also that the coal in different stages of transport from the pit to the distant consumer should be broken as little as possible, and a good deal of attention has been given to contrivances to secure these ends. On the Tyne coals were brought down to the river on the tramways and put into small barges called keels, holding about 20 tons, from which they were shoveled into the colliers through a porthole; or where the collier could be brought to the river bank, the coal was turned through spouts direct from the colliery wagon into the ship. There was no arrangement for meeting the difference of level caused by the tide. The first coal drop on the Tyne was put up by Mr. Thomson in 1813, and all subsequent drops have followed the same principle, which was the invention of Mr. William Chapman, of Newcastle. The loaded wagon in its descent raises a counterbalance weight, and when the coals are let out of the wagon, the counterbalance weight brings the wagon back to its original position. The machinery is controlled by efficient brakes. At Middlesbrough, from 1830 to 1842, the coal wagons were raised from the railway to the ship's deck and there emptied; but when the dock was constructed, special means were adopted for shipping coal rapidly and with as little breakage as possible. Ten drops were erected, connected with the railway by ten diverging lines; the loaded truck is run on to a cradle directly over the hatchway of the ship to be loaded, the cradle and truck descend perpendicularly to near the ship's deck, and the contents are discharged by the man who descends with the cradle operating a lever, and a counterbalance brings the cradle and empty wagon to its original position. The movement of the cradle is completely controlled by brakes, and it can be stopped with ease in any position. Each drop can ship about 150 tons an hour, and in 1845 these ten drops shipped over half a million tons of coal. About the same time Mr. Robinson contrived for the Bute Dock at Cardiff a mechanical system of staiths or drops to supersede the barrow system, by which coal brought down in canal boats was wheeled along planks into the ships. As the anthracite and steam coal are generally in large blocks, it is difficult use a shoot, and as the coal is very friable it cannot be dropped from any height. Mr. Robinson conveyed the ten-ton wagons along the staiths, lowered them to the ship on a balance platform which tilted when on the deck, and the coal was allowed to slide into the hold.

A great variety of hydraulic machinery has been designed by Sir William Armstrong for coal loading, and it is largely employed at Newport Docks and elsewhere. One of the best arrangements is thus described by the inventor: "The wagon is lifted vertically upon a cradle by the direct thrust of a ram beneath, and then tipped into a shoot large enough to contain an entire wagon-load of coal. This shoot also rises and falls so as to meet the varying height of the deck, the movement being effected by connecting the shoot with the cradle, so as to lift or lower it to the point required, where it is secured by proper fastenings. A pair of doors is fixed across the mouth of the shoot to regulate the flow of the coal or to stop it entirely. The tipping of the wagon is done by a press mounted on trunnions, which travels with the cradle and raises the back end of the platform, which is hinged in front, to the necessary elevation. For the initiatory process of forming a conical heap in the ship, an hydraulic swing-crane is affixed to the framework of the hoist, by which the coal is in the first instance lowered in an ordinary tub from the mouth of the shoot into the hold, and there delivered at the lowest possible level. All the movements are guided by valves, which are worked by a man who stands on an elevated platform at one side of the hoist. The same arrangement answers equally well for hopper wagons. In every case the wagons are brought up and taken away by means of hydraulic capstans, turn-tables, or traversing machines, according to the circumstances of each locality, and the rate of shipment is only limited by the trimming of coal in the hold, which must necessarily be done by hand labor."

Many different kinds of labor-saving machinery for dock and railway work in loading and unloading have been invented during the last fifty years, and have had a most important influence on the development of railway and steamship transport. Without such machinery it would be impossible that the present enormous commerce of the country could be carried on. If this machinery were suddenly withdrawn or disabled, the great ocean steamships must lie idle in port, and the greater part of the goods trains of the railways must cease to be dispatched. Adequately to describe the many kinds of cranes used at railway stations and in docks would occupy far more time than is at my disposal, according to custom, on these occasions. But you are all more or less familiar with them in daily use, for it is impossible to pass along a wharf, or through a dock, or important goods station, without being struck with the rapidity and ease with which goods are transferred by them from ship to ship, or from ship to shore, or from the platform to the truck of a railway train. Much of the work which was done by the steam crane is now done by the hydraulic crane, the first example of which, in a stationary form, was applied by Sir William Armstrong upon Newcastle Quay in 1846, speedily followed by hydraulic cranes and hoists at the Albert Dock, Liverpool. They were first applied to railway purposes at the Newcastle station of what is now the North-Eastern system, in 1848; and Mr. Brunel used by hydraulic power three years later not only for cranes, but for the movement of turn-tables, traversers, and capstans for hauling wagons at the Paddington station of the Great Western Railway, and now not only stationary, but portable hydraulic machinery is employed at most of the more important goods depôts throughout the kingdom.

Hydraulic machinery has also been largely employed for opening and closing dock gates and sluices, and for warping ships through the locks.

A large dock is in course of construction at Hull,

* Address of Mr. James Brunlees, F.R.S.E., F.G.S., Pres. Inst. C.E., as President of the Mechanical Science Section of the British Association, Southport Meeting, September, 1883.

by Mr. Abernethy, called the Alexandra Dock, where almost every kind of machinery which can be used in work of that nature is being used by the contractors, Messrs. Lucas and Aird, to expedite the work. Two of Priestman's steam grabs are employed, each capable of filling about 390 cubic yards a day, and are found very useful in opening out work for the steam navvies, six of which are employed, each capable of filling 600 cubic yards a day. There are a number of steam cranes, steam pile-driving machines, and steam jiggers at work. But beside those moved by steam power, hydraulic power has here for the first time been applied to machinery for the construction of works. An hydraulic crane puts the stonework of the dock walls in place; an hydraulic jigger raises the barrow-loads of soil from the bottom of the dock to the wall where it is shot to the back for filling. One of the six navvies is moved by hydraulic power; and there is an hydraulic pile-driving machine. The hydraulic machinery is found to work at least as quickly, as easily, and as economically as steam machinery, and it works almost without noise and quite without smoke. The trial of hydraulic machinery for these purposes has been quite successful, and where circumstances permit it will no doubt be used extensively in works of construction in future. For dock work much of the hydraulic machinery can be used permanently in the ordinary operations of loading and unloading, so that the loss by sale of such expensive plant, which a contractor has to take into account when making his tender, will be avoided, as it can be turned over to the dock company, with a reasonable deduction for wear and tear, at the end of the work. There are 2,800 men employed at this dock; and the work is carried on at night by the aid of the electric light. The mechanical navvies and grabs do the work of about 400 additional men.

The working of railways by electricity has not advanced further than to justify merely a brief reference to it in this paper as among the possibilities, perhaps the probabilities, of the not distant future. A line of a mile and a half of tramway has been working successfully at Berlin for over two years without hitch or accident of any kind. A line of narrow-gauge railway is constructed from Portrush, the terminus of the Belfast and Northern Counties Railway, to Bush Mills, in the Bush Valley, a distance of six miles, which is now partially worked by electricity, and is to be wholly so worked as soon as the necessary plant is completed. As the generating power is that of the abundant streams of the neighborhood, it will be economical; and if success should crown this practical experiment, it may lead to important results in regard to the employment of electricity under similar circumstances as a locomotive power.

I have now passed rapidly in review some of the more striking mechanical improvements in the construction and working of railways and docks which have taken place chiefly within my own experience. Each of them has had an influence important, if unnoticed, in promoting the growth of our railway and dock systems. Precisely how far any single appliance has contributed to create these magnificent systems, of which this country may with just reason be proud, it would be difficult to say; and it would be as difficult to say which of them could be despensed with without injury to the rest. They may be laid aside in course of time, one by one, as mechanical ingenuity devises new and better plans to take their place, and to meet the new and larger wants of other generations. But as the present age looks back with respect and veneration to the creation of those monuments of engineering science of which little more than ruins or even historic records remain, so will the generations which succeed us look on these, our works, as worthy, and as having contributed in no small degree to the greater and more general civilization to which we hope those who follow us may attain.

PANAMA.

The following description of Panama has been prepared by Acting British Consul Chamberlain:

Panama has increased in population since the establishment of the Interoceanic Canal Company. There are now in Panama and its immediate suburbs over 20,000 inhabitants according to last year's census. There is a village just being finished outside the town called Pueblo Nuevo, where a mixed population of West Indians and Colombians reside. Along the line of the canal there are about 6,000 British subjects, and at Colon they are fully 4,000 to 5,000. Panama, with the villages on the line and Colon, musters a population of 36,000 souls, of whom half that number are of British nationality. The town itself has not much benefited by the increase. The four public squares—Cathedral, St. Anne, Triumph, and St. Francis—have not improved in appearance. The Cathedral square is formed to the north by the bishop's palace, on the south by the Canal Company's offices, and on the east and west by private residences. The main street, running direct east and west, passes through the Cathedral square. The other squares have no particular public or private edifices worth mentioning. The few there are, such as convents and churches, are in a state of ruin. The St. Anne square is reserved for feast days, where bull-fighting and public amusements are indulged in. The streets are, as usual, in the same state and style as they were years ago—very inconvenient for those who are not accustomed to walk on angular stones. The buildings have no particular style of architecture; they are generally of stone, and no symmetry is observed in their mode of structure. The cathedral is the only building worthy of notice, being built in the time of the Spaniards, and dates from 1760. It is in the Byzantine style, and its towers are covered with oyster shells (rough mother-of-pearl). Red tiles made of clay, and hardened by being exposed to a certain temperature, are used for roofing. A great many buildings are being constructed, owing to the great profits attached to house rent, which is exorbitant. A house containing six or seven rooms is let for £20 per month; a simple furnished room cannot be obtained for less than £6. The drainage is very imperfect, and the sanitary condition of the town is only preserved by the torrents of rain which take place during seven months of the year. These rains, which occur nearly every day during the wet season (April to November), sweep away all the offal of the streets, and cleanse both the drains and the streets during these months; regular streams run down the streets and carry all before them into the sea. The town is admirably constructed for these deluges to have effect, the city being partly on a tongue of coral and basaltic rock stretching out into the sea, and partly on a gentle rise toward the Mount Ancon. When the rain falls these artificial rivers take their sources from the sides of the mountain, descend impetuously to the middle of the town, where the water divides itself into several streets and lanes, and empties itself on each side of the spit. These rains not only are beneficial in acting as a municipality, but supply the population with water, The first falls are not generally gathered for drinking, as they sweep from the housetops dust, dirt and decayed vegetable matter. Panama in the dry season has no water. It is brought from sources and rivulets miles away from the town in water-casks, where the vendors make a handsome profit. The rivulet which supplies Panama with water is called Matasnillo. Three buckets are generally sold for 6d. It costs a family 4s. or 5s. per day for the element during the dry season. Nearly all the wells are dried up and the cisterns exhausted at the end of January, so the inhabitants during February and March are obliged to purchase water. A most extraordinary phenomenon occurred on March 8 of the present year. There were two wells in Panama, which boasted of their perennial source, graciously employed in supplying water to the inhabitants of the town. On the above date we had a very sharp shock of earthquake, which lasted 25 seconds; the owners of the wells were surprised the next morning to find their wells completely dry, the earth itself at the bottom of the wells being found to be hard and apparently parched.

The climate of Panama during the dry season (December to April) enjoys a steady and equal temperature of 27 to 29 centigrade. During the wet season (April to November) the heat is very oppressive, owing to the great dampness of the atmosphere, and the want of breezes. Light southerly winds prevail during the wet months, and strong northerly trade winds during the day. A singular coincidence to be remarked at Panama is that the winds during the dry season fall and rise with the tide. This phenomenon also takes place with the wet season, where, at low tide, there is scarcely a breath of air. The showers generally fall at this moment, preceded by heavy storms of thunder and lightning. The air is charged with electricity, and heavy rain-clouds hand over the Isthmus, which melt in heavy showers as soon as the electricity is discharged in the form of fork and sheet lightning. Within my recollection I have seen buildings struck by lightning; the towers of the cathedral were struck last year, and several large masses of stone were detached by the stroke. Notwithstanding the frequency of these accidents from lightning, there is not a single lightning conductor in the whole town. The railway wharf received a discharge in October last, which tore up and splintered several planks. Three people were killed on the Savanna.

The Isthmus is covered with thick vegetation: the wonderful verdure grows pell-mell; the variety and luxuriance are marvelous. Great trees overshadow an interminable and impenetrable jungle of lesser growth, made up of an endless number of nameless plants and vines, all pushing, struggling, clambering toward the light. The flora is perfectly gorgeous and bewildering in beauty and variety. The solar rays cannot penetrate such layers of thick foilage, and the soil always remains saturated. Emanations and effluvia, which arise from the surface, being deprived of the sun (who extracts dampness and destroys decayed vegetable and organic matter), are the main cause of the various kinds of fevers in the country, such as yellow, typhus, malignant, remittent and intermittent. The only specific used by medical men is quinine; the natives use a bitter tamarisk, of which they make a febrifuge. There were 130 lbs. of quinine used last year on the Isthmus, and valued at £3,000.

Panama will become healthier when the city is provided with water-works. A company has been lately formed, to whom a concession has been granted. Mr. Sosa is the engineer who holds the contract for the conducting of the water to the town, and the Franco-Trading Company have the principal shares, in conjunction with a New York firm. The works are to be constructed and handed over in two years (1885) at a cost of £50,000. The water will be brought from the Rio Grande at a distance of about seven miles in iron pipes. This will be a remarkable improvement to Panama, and a great boon to its inhabitants. Gardens will be planted which could never exist before, owing to drought and expense of water in the dry season. The squares will be embellished and rendered pleasant. The dust will be laid, which is most disagreeable in the dry season, and causes, I am sure, the greater portion of diseases of the chest, which are so prevalent in this period of the year.

There are not many religions. Catholicism predominates. The Jews are numerous. There are no places of worship for any other denominations but Catholics. Protestants generally unite in some appointed place; so do the Jews. Neither of these denominations has any public buildings of worship. There is an assembly house, a presidental residence, a cathedral, a governor's office, and courts of justice. Both these latter are not very imposing structures.

There are several inns, but no really good hotels. There is only one passable, which is frequented by nearly all passengers in transit. A great many persons resident in Panama board at the hotels and live in furnished apartments. There are a few restaurants; one or two are very comfortable, but the remainder are of a very ordinary class. There are three main streets; the others are of no length or breadth, and are kept in indifferent repair. There is but one single road leading to the Savanna, about five miles in length. In the dry season the dust is suffocating, and in winter it becomes almost impassable from the lakes and mud. The Savanna is a large open plain, studded here and there with mounds and hillocks, on which are built châlets, where the Panamanian families resort during the dry season to obtain change of air. The great curse attached to this villagiature is the coloradillas, small insects like a stick (*pulex penetrans*), where they are found in myriads in the dry grass. They penetrate the skin and produce violent itching. The natives destroy the insect, and allay the irritation with frequent ablutions of camphorated spirit and tobacco-juice.

The only existing promenade in Panama is on the ramparts, which were built by the Spaniards in the sixteenth century, at a cost of $16,000,000. The ramparts are situated at the end of the spit on which the town is built. There is a paved road about 400 yards long which leads to the platform. At the end the height from the sea level is 40 ft., the breadth is 60 ft., and the length 200 ft., all constructed with solid granite. Underneath the ramparts is the prison in which convicts are lodged. It is a very damp, dark location, and the cells are not particularly large, nor are they clean. There is another prison on the square, St. Anne, where prisoners are also confined. It is somewhat similar to the former; there is little accomodation of any shape for the inmates, and the rooms are too crowded to be healthy. The smells, too, are not particularly sweet.

There is a good market in the middle of the town, where beef, tropical fruit (bananas, mangoes, plums, etc.) and vegetables can be purchased. Living is very expensive and is on the same scale as rent. The fact of there being no smaller coin than five cents proves that all purchases must be in accordance. On account of there being no copper money, the smallest articles have to be paid for with silver. All silver coins circulate and are received in payment. Gold has a very heavy premium—18 per cent. for English, 24 per cent. for American and 17 per cent. for French, on the value of the "sol" or "peso." It costs a family, living modestly, from £60 to £80 per month.

The Isthmus for fifty years was not visited by any phenomena such as earthquakes, etc.; very slight oscillations were felt, but nearly imperceptible to a great many. Lately we have had a succession. The first that took place after this long silence was on September 7 last, at 2:30 A. M. The city was roused by a severe oscillation from a rumbling noise. The façade of the cathedral was destroyed, the columns and balconies of the Parliament House were thrown down, and several public and private edifices were rent. Since then we have had a series, varying in intensity, from three to five per month, and the extraordinary coincidence exists that they are regular and more severe at the new moon.—*The Architect.*

THE IDEALIZED JAY GOULD.

Mr. John W. Mackey, though doubtless he has his own personal interests to serve by so speaking, says, very truly, that timid people are making a great bugbear of Jay Gould. "He is the most hated and most overrated man in New York," says Mr. Mackey, and he adds that "capital is not so powerful as people think."

Mr. Gould's great opportunity has doubtless been in the timidity of other people, and especially other capitalists. He has played on their fears, and bluffed them. The estimate of his powers has come to be so greatly exaggerated that even the superhuman is supposed by many to be almost within his marvelous capacity.

An ever-present cause of doubt and disturbance in Wall street is fear and suspicion of Jay Gould, as if he were the very devil himself, with all the hosts of the satanic kingdom at his disposal. He knows how to profit by the timidity he excites, though his sinister reputation is also a damage to him when he happens to have the truth on his side, and would make of himself a pillar of support instead of an engine of destruction.

It is also true that capital is not so powerful as many people imagine. When it is supposed to be most arrogant, it may be trembling with anxiety or hesitating with doubt, especially when it is invested in speculative enterprises or enterprises dependent on popular support or in danger from the interpretation of the law or from new and adverse legislation.

Jay Gould is a courageous operator and a clear-headed and cool-headed manager and organizer. He has got over most of his illusions, and has qualities which may not be common in Wall street or among those whose money Wall street seeks to get; but there is nothing mysterious about his success. He is helped amazingly, moreover, by the popular and broker idealization of him as a financial magician.

The contemplation of the portrait of Jay Gould drawn by the fears of his possible victims must give amusement to this wearied financier, now that he has had to postpone his voyage around the world in search of rest from carking cares and exhausting anxieties.—*N. Y. Sun.*

MODERN EDUCATION.

The man who has a good knowledge of chemistry, who can analyze ores, for instance: who can tell the composition of minerals, or of food-stuffs, has that which is not only useful to himself, but to the community in which he lives. He can readily obtain employment anywhere. Nobody wants a person who only knows Greek. In acquiring the nomenclature of chemistry and a knowledge of its details the memory is cultivated certainly as much as trying to acquire a smattering of Greek grammar and terminology. A knowledge of electricity—which is to be the great power of the world, the nervous system of modern civilization, and the agent of modern progress—will be of the utmost practical use to every educated man of the future. But how little about this is taught in our high schools and colleges! How little is attempted to be taught! One or two students perhaps know something about Leyden jars and galvanic batteries—as much as was known 200 years ago—and may be able to complete a circuit, but that is the extent of their knowledge.

THE TRADE IN BUILDING MATERIALS.

We take the following from *Bradstreet's:* A survey of the amount of building going on in our chief cities and throughout the country induces the belief that the scale of operations for 1883 will prove larger than it has been for years. The applications for building permits—some of these, however, being merely extensions and improvements—made at the Building Bureau of New York city in the first six months of this year amounted to $30,000,000, and although all authorizations are not at once acted on, the new buildings in progress, with those continued from last year, or commenced in this under previous permits, represent figures equal to two-thirds of the above amount. In New England and the northwestern sections of the country building is particularly active. In our great commercial cities the present year will be distinguished by the massive and costly structures commenced or completed. In New York the chief activity is in apartment houses on an unprecedented scale, some of the blocks approximating, with cost of land, to half a million of dollars; a number of costly churches are also going up, while of commercial buildings of a more than ordinarily imposing character—buildings indicative not only of the growing wealth of the business community, but of advancing taste as respects embellishments and conveniences—there has been a fair quota. Large structures suitable for their purpose are on all hands found to be the most paying, and the confidence of capital in satisfactory returns from these is leading to increasing investments.

This country has the advantage of great capability in producing varieties of building materials, but the contiguity of the British Provinces leads to such importation as freestone and laths, and in cements, a comparatively new industry in this country, a considerable importation takes place from England and the Continent, which has reached so far this year to about 150,000 barrels. Scotch freestone for basements and trimmings is being imported on an increasing scale. On the other hand, we export our bluestone to Canada, Cuba, Mexico and South America, its special qualities recommending it for flagging and lower courses of buildings. The bluestone granite and marble of New England handled in this city are chiefly brought here by water. All over the country cost of transport necessarily governs to a great extent the selection of stone for building, though with certain important edifices distance is allowed to offer no impediment to the conveyance of huge quantities of New England stone to remote Western cities.

The business in granite, owing to the larger scale on which buildings are now constructed, increases year by year in this section, Maine, which may be regarded as a granite State throughout its length and breadth, supplying the larger proportion. The price of ordinary granite ranges from 75 cents to $1 per square foot; but superior qualities, which allow of a fine polish, present an attractive surface, and are not liable to become discolored, will realize as much as $10 per foot. Notwithstanding the costliness of granite, entire buildings in different parts of the country continue to be erected of this material. The stone is cut and fashioned at the quarries according to the architectural drawings, and thus, on arrival, has only to be set in place. So with a great portion of the freestone used here. The most extensive employment of Maine granite in this country has been in the construction of the piers and approaches of the East River Bridge. There is extreme competition among the granite quarrymen, and, owing to the abundance and variety of the stone, new specimens are being continually brought to market, but it is difficult to place any new description. The brownstone with which New York is supplied, only obtainable from beds of limited location in Paterson, N. J., and Portland, Conn., is, as a consequence, well controlled by the quarry owners. Their sales are chiefly in New York, Brooklyn and Boston. The stone goes no further than Pennsylvania.

Bluestone has been employed for flagging and building purposes for half a century, but its extensive use has been more recent. Previous to the adoption here of the North River stone the quarries on the Connecticut River were chiefly drawn on for New York flagging. Pennsylvania supplied New York with a moderate proportion. This stone, which is extensively used for trimmings, for buildings, for water tables, lower cells, lintels, large platforms, and for rubbing and polishing, goes to all parts of the country. The cost of the rough-quarried stone handled here does not exceed $3,000,000 per annum, but the labor expended in shaping it, with cost of freight, brings this amount up to $9,000,000. The figures given for freestone (brown) by qualified estimators closely approximate to the above. Cost of labor in cutting and dressing both bluestone and freestone has been greatly reduced of late years by the powerful iron planers employed for these purposes. The marble used in this section, a good part of it employed in interiors for mantels, is from Vermont, which supplies every desirable quality and color. Limestone from Ohio, Indiana, and even more distant States, is also furnished. An important contribution to our building materials is in Portland stone from Kentucky, of similar quality to the famous English stone of that name.

Artificial building stones have come into prominence of late in the way of concrete blocks, tiles, etc. Of these, terra-cotta, both for purposes of ornament and utility, is the most prominent, being widely used for architectural trimmings, carved moldings, bands, cornices and for porches. It is found suitable for substantial work in which strength and durability are primarily essential. Terra-cotta has served in an important degree to aid the present general adoption of brick in structures by affording effectual contrast and aiding in picturesque design. The brick trade of New York is enormous. The supply is chiefly obtained from North River establishments, which furnish every desirable variety of texture, form and color. The number handled in New York alone may be put at from 700,000,000 to 800,000,000 per annum. The average cost, estimated by the carload, is $6 to $7. The cost is affected not only by the activity of building, but also by the favorable character or otherwise of the season for the manufacturer. Enameled bricks for lining interiors and for floorings are extensively imported and to some extent manufactured in this country. Some new buildings contain several hundred thousand. Construction iron enters more largely than ever into our buildings, and ranks essentially, though not nominally, under building materials. Estimates for the quantities required are obtained by architects or contractors direct from the iron foundries, whose works are on a large scale. Iron has found uses in building never dreamed of in the old timber days, being adapted for beams and girders, pillars, stairways, balustrades, floorings and landings, and for first stories of store frontages. Omitting from the present notice other building materials, we may mention that 150,000,000 laths are sold in this market annually, half the amount coming from St. John's, N. B. Of lime, 1,500,000 barrels are placed each year on the New York market. In Portland cement, both in foreign and home manufacture, an increasing business is being done. The 16 cement manufacturers of Rosendale, Ulster County, N. Y., alone supply 1,600,000 barrels per annum. There are about the same number of manufacturers in Louisville, Ky., and in Pennsylvania.

PAPER GAS PIPES.

Paper gas pipes are made by passing an endless strip of hemp paper, the width of which equals the length of the tube, through a bath of melted asphalt, and then rolling it tightly and smoothly on a core to give the required diameter. When the number of layers thus rolled is sufficient to afford the desired thickness the tube is strongly compressed, the outside sprinkled with fine sand and the whole cooled in water. When cold the core is drawn out and the inside served with a waterproofing composition. In addition to being absolutely tight and smooth, and much cheaper than iron, these pipes have great strength; for when the sides are scarcely three-fifths of an inch thick they will withstand a pressure of more than 15 atmospheres. If buried underground they will not be broken by settlement, nor when violently shaken or jarred. The material being a bad conductor of heat, the pipes do not readily freeze.

WOOD PAVEMENTS.

The use of the modern wooden pavements in London is extending. Asphalt holds its place, but that is all. Wood pavements have been laid where stone pavements have been removed. The municipal authorities of New York have abandoned wooden pavements on account of the danger of their harboring filth and disease. London is better adapted to wooden pavements than New York, because the latter is built on rock, and all the moisture is trapped, as it were, in a few feet of soil, and thus the evil spoken of is produced. But if the streets of London are kept clean they ought to be able to avoid this. There are several varieties of wood pavement. One variety is that which is placed (creosoted blocks) in a bed of cement concrete, which is rendered watertight by a filling of asphalt and gravel. In another the blocks are laid on a flooring of boards interposed between them and the cement. In still another way the blocks are of yellow pine, not creosoted. These are laid on concrete, a carpet of tarred felt being interposed between the two, and strips of felt are placed between the blocks; the whole is then covered with hot asphalt, which runs into every crevice, and this, on being crushed, makes a hard substance, which is of considerable durability. Wooden pavements are by some authorities believed to be healthy and practicable in London, even if not in New York.—*Bradstreet's.*

PROGRESS OF THE PANAMA CANAL.

The Paris correspondent of the *Times* gives the following account of the state of the works and the prospects of the canal: "M. Dingler, director-general of the works and a civil engineer of good standing, recently arrived in Paris to submit his plan of campaign for the season of 1883-84. The amount of cubic metres to be removed, as estimated in the original survey is exceeded in the definite programme based on soundings and experiments by machines and manual labor; 80,000,000 cubic metres had been calculated on, whereas there will be 100,000,000. These, however, it is calculated, will cost less than the 80,000,000 would have done. In the original specifications three-fourths of the isthmus to be cut through were reckoned as very hard rock. It is now affirmed that the very hard rock does not exist, and even the hard rock is much less thick than a survey had indicated. There are geological explanations of this phenomenon. The soil being thus much less refractory than was originally supposed the mode of cutting has been changed. The embankments of the canal, which in the rocky part would have been almost like vertical walls, will be flatter, involving the removal of more cubic metres. This accounts for the total of 100,000,000 metres instead of 80,000,000. But the first excavations, according to the engineers, would have cost 10 francs a metre, whereas the new work will only cost on an average a third of this sum. The 100,000,000 of cubic metres to be removed, with the accessory labor, expenses of administration—in short, with everything included, may be expected to cost in all 500,000,000 francs. With 100,000,000 francs for

meeting the unforeseen, a total of 600,000,000 francs is the expenditure indicated by M. de Lesseps for the completion of the canal, provided, of course, there is no new miscalculation. There is another very important point. It was believed at the outset that the canal might be ready in 1888, viz., five years. Last year this calculation became a certainty. According to the new plan of campaign about to be submitted to the consultative commission, composed of admirals and the chief engineering authorities, the completion of the canal in 1888 is no longer doubtful, but if the directorate of the company wished, by increasing the machines and opening new work-yards, a thing acknowledged to be easily practicable, the date of completion might, it is said, be accelerated by some months, perhaps a year. The unexpected fact is reported that at some yards, whither machines had been brought to perform the excavations, the negro workmen hired in great numbers merely as hodmen asked to be allowed to do the excavating themselves, and have, in fact, succeeded in doing it cheaper. The machines were, therefore, conveyed to another yard. It appears from reports of travelers that M. de Lesseps' popularity in the isthmus is as great as here. The workmen are astonished at the care with which they are treated, and the regularity with which their wages are paid.. Lord Granville's statement that her Majesty's Government could never have two different policies, one at Suez and another at Panama, produced a lively impression in the United States of Colombia, and another impression—an impression of 'attentive supervision—at Washington. A New York paper has said that the Government of the United States had a good preceptor, who cost it nothing—viz., the English Government: By doing in the future at Panama exactly what the English government would do at Suez, it would be sure of not going wrong. It may be added that M. de Lesseps has very dextrously confided the execution of the two entrances of the canal to leading American contractors, and public opinion at New York and Washington has become very favorable to the enterprise. M. de Lesseps is not the man to miss such an opportunity. He therefore wishes to hurry on the work as fast as possible, in order that the canal may be finished while the favor lasts, and there is no doubt that after the new issue operations will be resumed with renewed vigor. At M. de Lesseps' age it is natural for him not to wish to delay the moment when a second apotheosis will take place, for few enjoy it even but once. In any case it seems certain that the Panama canal will be traversed in a few years as the Suez canal is now."

UNITED STATES CENTRAL R. R.

SAN FRANCISCO, Oct. 30.—Articles of incorporation of the United States Central Railroad Company, with a capital of $75,000,000, were filed today at Denver, Col., with headquarters in this city. "The opening of this road," said Chief-Engineer Lyman Bridges to an Associated Press representative, "will be the most important event to the people of San Francisco since the Central Pacific was opened." Among the road's promoters are W. W. Walker, President of the St. Louis & Hannibal road; John Sharp, President of the Utah Central; Richard King, of the National Bank of Commerce, New York; John L. Beveridge, ex-Governor of Illinois; John C. Short, President of the American Finance Company, New York; Alvah Mansur, of St. Louis; E. Raudett, Isaac Cooper, D. R. McDonald, President of the Pacific Bank of San Francisco. The company is a consolidation of the San Francisco & Ocean Shore, California Central & Denver, Hot Springs & Pacific companies.

The road will be of standard gauge and will run from San Francisco to Denver via Santa Cruz, crossing the Southern Pacific and Minturn, through the Big Trees and Yosemite and over the Sierra Nevadas at the headwaters of the San Joaquin River to Crystal Springs, Nev. From there a branch line will be built south to the Atlantic and Pacific in Arizona. Continuing from Crystal Springs, the main line will go to Iron Springs, Utah, from which a second branch of fifty miles will be built to Milford, the southern terminus of the Utah Central, making a connection with the Union Pacific. From Milford the road will run in an easterly direction via Hill's Valley and Morrison to the Denver road, already located 800 miles east from San Francisco and 200 west from Denver, and will when completed be the shortest road over the easiest grades between the two cities.

Should no difficulty be encountered in obtaining an entrance to San Francisco, the road will prove a formidable competitor to the Central Pacific. At an election of officers held this afternoon, W. W. Walker, of the St. Louis & Hannibal road, was elected President, and John Sharp, of Salt Lake City, and E. T. Wells, of Denver, Vice-Presidents. The construction of the road will be commenced immediately.

[W. W. Walker has for many years been prominent in Western railroad circles. He has been especially intimately associated with the Blair railroads of Iowa and was for many years resident at Cedar Rapids, where he held the position of Vice-President and Chief Engineer of the Cedar Rapids & Missouri River R. R., now the Western Iowa Division of the Chicago & Northwestern R. R. Mr. Walker is a member of the American Society of Civil Engineers, as is also Chief Engineer Bridges.]

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

DLXXIV.—MILTON, PA.

(*Continued from page* 512.)

Milton, Pennsylvania, in lat. 39° N., long. 73° 10' W., is in a rich farming valley on the north branch of the Susquehanna River. Settled in 1790, it was incorporated a borough in 1814.

Water-works were built by a private company in 1883, after plans of George H. Pierson, C. E., taking the supply from the river and pumping it 144 feet by a Worthington steam pump of 18½ in. steam and 10 in. water cylinders, and 12 in. stroke, into a reservoir 100 by 286 feet and holding 2,600,000 gallons, excavated in red sand stone and lined with a stone pavement on clay puddle.

Distribution is by 6¼ miles of cast-iron pipe of 12 to 4 in. diameter, with 37 fire hydrants and 30 gates. The number of taps is not given. The town pays $1,000 per year for use of 37 hydrants. Service pipes are of galvanized iron and lead.

The population in 1880 was 2,102, and is reported to be now about 6,000.

The capital stock of the company is $40,000. The works have cost $36,000. They are just completed. R. F. Wilson is the president and manager.

THE GREAT WATER-METER JOB.

A decision of much importance to the City of New-York was rendered by the Supreme Court, General Term, last week. By it the judgment for $1,126,148.13 entered against the City by John Baird, on the report of a Referee, is reversed, and a result has been achieved for which the law officers of the corporation have been laboring since 1874. The suit grows out of the famous "water-meter job." In 1870 William M. Tweed and "Aleck" Frear were members of the Legislature, in addition to being Commissioner of Public Works and Commissioner of Charities and Correction, respectively. As legislators they procured the passage of an act authorizing the Commissioner of Public Works to cause water-meters to be put into hotels, manufacturing establishments, and all buildings generally in which large quantities of water were used. At that time Mr. Jose F. Navarro was largely interested in the manufacturing of such meters, and subsequently "Aleck" Frear obtained a share in a patent meter. Frear brought Tweed and Navarro together, and on Aug. 22, 1871, Tweed, in his capacity of Commissioner of Public Works, made a contract with Navarro, in the presence of Frear as a formal witness, for the delivery to the city of 10,000 meters at a cost of $70 each. The meters were all to be delivered before July 1, 1872. Less than a month after the contract was signed Navarro delivered almost half the required number, and the remainder he turned over to the city within the stipulated time. Tweed accepted them as fast as delivered, and drew warrants on the City Treasury for the payment of Navarro.

In the meantime, however, Mr. Andrew H. Green had succeeded "Slippery Dick" Connolly in the comptrollership, and he refused to pay the money. He based his refusal on the theory that the act of 1870 did not authorize such a contract as had been made by Tweed with Navarro, and on the fact that the meters were worthless, of which fact he was informed by a commission of experts, headed by Mr. Allan Campbell, the recent comptroller. Mr. Campbell and his associates subjected the meters to a test under the water pressure here and in Brooklyn and found them to be defective. They have since been stacked up in the pipe yard of the Department of Public Works. After fruitlessly pressing Controller Green to pay him $700,000, with interest from 1871, Mr. Navarro assigned his claim against the city to John Baird, who had previously been interested in patents for water-meters. Baird then began the present suit. In March, 1874, Judge Donohue appointed ex-Judge John K. Porter a referee to try the case. The city asked to have this order vacated on the ground that Judge Porter, having long acted as counsel for Mr. Navarro, was not a proper person to determine the issues. This application was denied, and the order of denial was affirmed on appeal. The case was therefore tried before Referee Porter, who, on Oct. 9, 1880, reported in favor of Baird, awarding him the principal of $700,000, with $415,319.96 as interest from Sept. 17, 1871, making the total sum of $1,115,319.96. In his report Judge Porter declared that Navarro had made and carried out the contract in good faith, and that no proof had been given by the city that there was a corrupt understanding among Navarro, Tweed and Frear. By the time judgment was entered against the city the sum for which it was held liable to Baird had grown to $1,126,148.13.

In reversing the judgment, the Supreme Court, General Term, declares that the contract between Tweed and Navarro was not authorized by the act of 1870, and was not necessary to carry out the purposes of the act. Beyond this the court determines, from a review of the evidence, that there was something wrong in the making of the contract, inmuch as the price fixed upon for each meter was apparently $40 greater than the fair value of the instrument. So large a profit to the contractor must, the court holds, be considered in the light of a gratuity, the giving of which could not be justified or excused in the case of a public officer like the Commissioner of Public Works, who was bound to see that the public money was not misapplied either to the benefit of himself or of others. From the allowance of such a generous profit, it seemed probable, the court holds, that some other relation than mere intermediary or agent existed between Frear and Tweed and Navarro. The General Term, therefore, reverses the judgment, and orders the case to be tried anew, before a jury. The opinion of the court was written by Judge Daniels, and is concurred in by Presiding Judge Davis and Judge Macomber.

CENTRAL PARK ESTIMATES.

Park Commissioners Vielé and Crimmins explained to the board the estimates of the Park Department, which call for $1,107,500. This year the department received $732,000. They needed, the Commissioners said, $45,000 for salaries of all employés of the department except mechanics, gaadeners, laborers and their foremen, topographical engineers, and Superintendent and Engineer in charge of roads and public places in the Twenty-third and Twenty-fourth wards; $150,000 for the Park Police, $275,000 for labor, maintenance and supplies, $18,000 for the Zoological Department, $30,000 for museums, $12,000 for music, $30,000 for Harlem River bridges, $30,000 for park walks, $50,000 for Central Park transverse roads, $20,000 for Riverside avenue, $75,000 for Riverside Park, $115,000 for maintenance and government of roads and public places in the annexed district, $10 000 for Bronx River bridges, $15,000 for sewers and drains, $30,000 for surveying, laying out, etc., tax and assessment maps; $25,000 for surveys, maps, and plans; $25,000 for drainage and irrigation of Central Park, $50,000 for a propagating house in Central Park, and $50,000 for Central Park construction.

NORTHERN PACIFIC RAILROAD.

From Mr. J. W. Kendrick, chief engineer of the St. Paul & Northern Pacific Company, resident at Minneaapolis, the Minnesota *Tribune* of Oct. 28 learns the following facts:

The grading of the new independent line from New St. Cloud to Minneapolis was let to Langdon & Co. Work was commenced Sept. 1, and the 60 miles will be completed in about two weeks from the present date, a remarkably rapid piece of work. The new grade begins at East St. Cloud and parallels the east side of the Minneapolis & Manitoba track, being distant from it 15 ft. from center to center. The track-laying contract is let to Winston Bros., and will be pushed to completion with their customary energy. Track-laying is already progressing from Clear Lake, and after Nov. 1, work will be crowded. The masonry on the line is of the most substantial and enduring character.

The contractors for this work are Saulpaugh & Co., who have done some of the heaviest work in the country, notably the masonry for the Cincinnati Southern railway at the Ohio river crossing, the Bismarck bridge across the Missouri, the Blair bridge and the Plattsmouth bridge, also across the Missouri.

The stone used is the St. Cloud granite, from Saulpaugh & Co.'s Rock Island quarry, at East St. Cloud, Minn.

The bridges on the line occur at Elk River, one span, 143 ft. long; Rum river, two spans, each 162 ft. long; Coon creek, three spans, each 40 ft. long; Rice creek, three spans, each 40 ft. long; Mississippi river, five spans, each 164 ft. long.

The first will be a combination structure of wood and iron. Rum river bridge will be of iron. The bridges over Coon and Rice creeks will consist of 49-ft. plate girders. The Mississippi river bridge in Minneapolis will be a double track iron structure of the Pratt type of truss. It will consist as above mentioned, of five spans of 164 ft. each. These spans will be supported by four stone piers and two abutments.

The masonry is founded, if not on a rock, least on something as unyielding and which serv every purpose. Piles are driven 3 ft. apa from center to center in the space upon which t masonry is to stand. They are driven to a dep of about 20 ft. below the bottom of the rive The earth is then excavated from around and b tween them to a depth of about 7 ft. belo

extreme low water. The sides of the excavation are sustained by sheet-piling and the pit is kept dry by means of steam pumps.

The piles are carefully sawed off at precisely the same elevation at the bottom of the pit. Heavy timbers, 12 in. square, are spiked or drift-bolted to the tops of these piles, in two layers at right angles to each other. The spaces between the timbers are filled with beton (formed of hydraulic cement, sand and broken stone) and rammed. This forms an artificial stone which grows harder with age. The beton terminates in a perfectly level surface, 4½ ft. above the top of the piles as sawed off. Upon this foundation bed the masonry proper is built. The foundations of the piers differ from this. Piles are driven as for the abutments and are sawed off perfectly level, close to the bottom of the river. This is effected by means of a circular saw working on a vertical shaft under water, driven by a steam engine, supported by a staging built for the purpose. Great accuracy is necessary and is obtained. The space between the tops of the piles and the bottom of the river is packed with rock, which is finished off by a diver, so that none of it extends above the tops of the piles. This forms a firm, level bed to receive the masonry. The depth of water is from 8 to 13 ft. in the river at present stage. A caisson is provided for each pier. A "caisson" is simply a large boat having a very strong bottom, and temporary water-tight sides. It is floated into position over the prepared foundation and is held there in a dock constructed for the purpose. The masonry is then started in the caisson and care taken to keep it nearly level until it sinks to place. The masonry is then finished and the temporary sides of the caisson removed.

There is thus a timber platform under each pier, which is as indestructible as the rock so long as it is submerged. As it is five feet below extreme low water to the top of this timber and bottom of the masonry, it is not at all likely that the timber will ever be exposed unless the falls of St. Anthony lose their grip!

There was not enough water at pier 4 to permit the use of a caisson and the foundation was prepared as for the abutments. At present the east abutment is finished and pier 1 nearly so. The contractors for the foundations are Raymond & Campbell of Council Bluffs, Ia. It is hoped to finish the piers before the river freezes over.

The bridge superstructure will begin to arrive in December and will be in place Feb. 1, 1884. The superstructure is being made by Kellogg & Maurice of Athens, Pa. As before stated the spans are 164 ft. long over all, or 160 ft. between end piers. The trusses are 28 ft. 6 in. apart from center to center, and the height of truss is 30 ft. from center to center of chords.

The structure will be 25 ft. above the ordinary stage of water. Work is now in progress and many people visit the ground daily.

ENGINEERS' CLUB OF PHILADELPHIA.

ROOMS, NO. 1523 CHESTNUT STREET, PHILADELPHIA. PA.

DEAR SIR: Regular meeting, Saturday, Nov. 3, 1883, at 8 o'clock p. m.

Notes on Roads, Streets and Pavements.
Tides, and Newton's Theory of Them.
Notes on English Machine Tools and Centrifugal Pumping Machinery.
Dust Explosions in Mills.
The Effect of Frost upon Fire-plug Casings.
Notes on Boiler Construction.
Soegmuller's Solar Attachment.
Notes on Clepsydræ.

Record of Regular Meeting, Oct. 20, 1883.

President Henry G. Morris in the chair; twenty-three members and three visitors present.

The Secretary presented the memorial of the late John C. Trautwine, honorary member of the club, prepared by a committee consisting of Messrs. Frederic Graff, Strickland Kneass and D. McN. Stauffer, chairman. A very interesting sketch of a very interesting life is given in this memorial, and a truly deserved tribute is paid to a recognized leader in his profession, and a man among men.

Mr. John Haug exhibited and described very complete sets of drawings for two vessels designed by him: the one a tug-boat for the Philadelphia Board of Health, and the other a barge for the transportation of freight and passenger cars.

Mr. J. H. Harden read abstracts from a paper prepared for publication as part of the Report of the Second Geological Survey of Pennsylvania, relating to the "Early Mining Operations in Berks and Chester counties, including the Present Condition of the Jones Mine." A map of the Jones mine in 5-feet contour lines, scale $\frac{1}{240}$, drawn by Mr. E. B. Harden, and five photographs of the excavation, by the same gentleman, were exhibited. The paper includes a description of the ore, excavation, depth of exploring works, old copper shaft, machinery, quantity and cost of mining, older operations adjoining, indications of connection, prospects of the mines, proposed tunnel, possible output, extracts from Prof. J. P. Lesley's report on the mines (1864), latter prospecting at Warwick mines, quality of the ore, area of excavations, extracts from the minute books of the Berks and Chester Mining companies, early works at the mine, the Pennsylvania Copper Company, 1806 to 1811, furnaces taking their supply from the mines, etc., etc. Samples of the ore were exhibited.

Prof. L. M. Haupt presented notes on conventional colors for drawing.

HOWARD MURPHY, Secretary and Treasurer.

LIVERPOOL ENGINEERING SOCIETY.

The eleventh meeting of the Society was held on Wednesday, Oct. 19, at the Royal Institution, Colquett street, Mr. R. R. Bevis, Jr., vice-president, in the chair. A paper entitled "Electric Light Fittings Used in the Incandescent System" was read by Mr. A. B. Holmes. The author, in opening the subject, pointed out that the paper did not treat of the electrical generating machinery, but assumed the supply of electricity to be obtainable from some outside source. The various details of all the interior fittings were minutely described after some preliminary remarks on electrical potential. Different kinds of insulated cables and wires were shown, and the rules by which their proper sizes can be calculated were explained. Joints made by means of mechanical couplings were recommended preference to soldered joints. Several switches were exhibited, and also samples of the Edison, Woodhouse & Rawson's and Hedge's fusible safety plugs, which were described at length, and also the Anderson magnetic cut-out and the mercury safety contact breaker. Incandescent lamps and holders and the usual modes of arranging circuits were next dealt with. In conclusion, the various instruments used for measuring electric currents were explained, the examples selected being the Ayrton & Perry, Ammeter and Voltmeter, Edison's current meter, Boy's energy meter and the Hopkinson electricity meter. One of the latter instruments was exhibited and its mode of working described.

LABOR NOTES.

There will be a labor congress in Canada in December.

A Building League is being formed at Guelph, Canada.

Nine trades union representatives have been elected to the Ohio Legislature.

At Dallas bricklayers are receiving $6 a day. The general rate in Texas is $5.

A Reporters' Assembly is being formed under the auspices of the Knights of Labor in this city.

The Free Soil Society is rapidly organizing ward groups. There are nine in this city already.

The chiefs of the several State Bureaus of Labor Statistics will meet in St. Louis at an early day.

W. H. Forster, ex-Secretary of the Federation of Labor, has removed from Cincinnati to Philadelphia.

The Philadelphia Knights of Labor propose to erect a monument over the grave of Uriah S. Stevens.

In Milwaukee many machinists and iron workers are idle. Workshops are overcrowded. Wages are low.

The Brooklyn Central Labor Union is organizing a labor fair, to exhibit the work of wage laborers only.

The Telegraphers' Brotherhood is still in existence and flourishing. Most of the assemblies have withdrawn from the Knights of Labor.

The labor unions in St. Louis have reopened their headquarters at 950 Broadway, and have established a reading room and a lyceum.

Philadelphia mills and factories are full of work, and some of them are loaded with orders twelve months ahead of time. Small houses are in demand there.

The Knights of Labor will present to Congress next winter, through the Chairman of their co-operative Board, Henry E. Sharpe, of this city, a bill to encourage, assist and provide for the organization and settlement of co-operative colonies on the public lands.

General Secretary Foster, of the Knights of Labor, writes to Mr. Jarrett, of the Amalgamated Iron Workers, that the Order also is entirely neutral on the question of free trade against protection. Mr. Foster himself is an ardent free-trader and Mr. Jarrett is a protectionist.

The striking Pittsburgh glassblowers are circulating petitions for a reduction of the tariff on glass. They say the new tariff benefits the manufacturers more than the old one did, and that, therefore, there is no reason for asking the workmen to take twenty per cent. less wages.

Carpenters' wages at St. Louis are from $2 to $3 a day. Dakota carpenters are in demand at $3.50 a day. Living there is costly. In El Paso carpenters receive from $4 to $5 a day, but there is no great demand for them as yet. In Charleston wages range from $1.50 to $2.25. There is no Carpenters' Union in that city. The carpenters' strike on the Newport News elevator continues. A Carpenters' Union is being formed at Lynn, Mass. The Independent Union at Cincinnati is disbanded. San Francisco Union No. 22 has initiated 210 new members within three months. In Chicago the building trades are brisk, and carpenters' wages are $2.75 to $3 a day.

The State quarries of Bangor, East Bangor, and Pen Argyl, Pa., are increasing in productiveness daily. They are hampered only by the scarcity of skilled labor. So many quarries are being opened that labor is scarce. The towns are growing so rapidly that after an absence of a month from home a resident finds new streets open and new houses built. There are twice as many houses in Pen Argyl to day as there were on the 1st of January. Within the next two or three years, at their present rate of growth, Bangor, East Bangor, and Pen Argyl will be united as one great town.

In the entire region there is great demand for all kinds of labor. Ordinary day laborers earn from $1 to $1.35 per day, and often more, according to the exigencies of the occasion. Carpenters earn $2.25 to $3.25. Bricklayers find work, but most new buildings are frame. Machinists are sought after daily, and make good terms, because practical men to work at the opening of new quarries and the erection of machinery are scarce. Slaters (splitters and dressers) earn from $2.50 to $4 and $4.50 per day by the piece. Quarrymen can always find remunerative employment. The growth of the industry here has been so rapid, and population increases so fast, that boarding accommodations are not first rate, but they are improving.—*N. Y. Sun.*

WATER POWER IN NEW ENGLAND.

There has not been a time in many years when the water in the various streams and rivers has been so low as this season. Streams which have never given out before have been so low that they were practically worthless, and this emphasizes the fact that the steam engine is the coming power, for the long-vaunted water power of New England is giving out. Various causes have appeared to make the water power less, and even less than it was supposed to be, and these causes have been working all the time and increasing in practical effect, so that now it is giving out almost in every place of any account, with some few exceptions, where the timber has not yet been cut off back in the sources of supply on the hills or mountains. The effect upon the goods trade upon this account is already appreciable, and there is a demand for the best kinds of cotton, which was not expected so early in the season, if we are to take all the views which are expressed upon this matter and put them together. The curtailment of production on account of the drought will work, in the present state of the market, a very great advantage, and really it will be out of reach of buyers to make a break in prices of manufactured cottons, for the reason that the supply is very much cut down at present. In this way it will make a brighter fall trade and a better outlook for the winter trade, more especially if we have such a winter as we have had in two or three instances where the water has not been in its usual quantity until almost spring, instead of early in the fall, as usual, and it will be another instance of exceptional conditions to prevent the market from breaking down under the load of accumulated goods. One thing is far beyond question now, and that is that the water power of the Eastern States is fast fading away, and that it is less than it was a few years ago, and is growing less each and every year. Let us look, therefore, to steam with a clearer eye, and learn more of it, and how to handle it, so that we can keep up the busy wheels of the million of cotton spindles, and thousands of sets of wooden machinery. Water power in the Eastern States is doomed, and it will not be long until we are a steam spinning section of the country.

THE LITIGATON ABOUT THE CANTILEVER BRIDGE.—LOCKPORT, N. Y., Nov. 1.—A railroad case involving new and peculiar legal technicalities of interest to all railroad managers is being sharply contested here. John E. Pound of this city and Hans Neilson and Benj. Flagler of Niagara Falls are Commissioners appointed by Judge Haight of the Supreme Court to appraise certain property belonging to the Witmer estate, on the American bank of the Niagara River, upon which approaches to the new Cantilever bridge are built. This property the Canada Southern road could not purchase at satisfactory prices, and, to avoid delay, went on to the premises and began operations. They built the costly abutments, piers and approaches at an expense of about $75,000 or $100,000, and now meet with opposition. The Witmers claim that the railroad company are trespassers, they are entitled not only to the full value of the land, but also to the increased value it has acquired by the extensive operations of the bridge builders thereon, and that all improvements belong to them.

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

Tribune Building. New York City.

The Engineering News Publishing Company, Proprietor.

Published Every Saturday.

CONDUCTED BY
GEO. H. FROST and D. McN. STAUFFER.

TERMS OF SUBSCRIPTION:
$4.00.....PER YEAR TO U. S. AND CANADA.
$5.00..... " " " FOREIGN COUNTRIES.
Make all drafts and cheques payable to ENGINEERING NEWS PUBLISHING CO. Postal Money Orders, for convenience, may be made payable to GEO. H. FROST.

THE City Council have ordered measures to be taken towards lighting with electricity the entire water-front of this city.

WE apologize to the able editor of the published "Foreign Abstracts" of the Institution of Civil Engineers for not giving due credit for two short articles in our issue of Oct. 6: one upon "Cement Concrete," and the other upon "A Scale of Hardness for Metals." Credit was inadvertently given to the foreign periodicals alone in which they originally appeared, without mention of the journal which took the trouble to first translate them from the German.

THE DANGER FROM WATER IN UNDERGROUND WORKINGS.

In estimating the item of probable cost of the proposed Croton Aqueduct we trust that due attention has been paid to the possibilities of meeting with water in the extensive tunneling required by the present plan, especially upon the Saw-Mill route, which, as we understand it, passes below the drainage basin of that valley.

The rain falling upon the earth's surface is disposed of by passing through natural or artificial water courses to the sea, by evaporation and by percolation into the soil. The last-named quantity, if above the sea-level, must also ultimately pass into the sea, generally by subterranean channels; for it cannot escape by evaporation, and the soil cannot be indefinitely charged with fluids. This means brooks, rivers and lakes beneath the earth's surface, similar to the channels and reservoirs mapped out upon the surface, but with the important difference that their location and direction, as well as extent, are not traced upon our charts.

Geologists recognize certain strata as waterbearing, as being more permeable to water than others, but neither geologist nor engineer can definitely foretell just what is under or before him in any stratum. The most solid appearing rock *may* conceal a water course lying directly in the path of operations. If it does so occur, the engineer cannot bridge it, he must exhaust its source; and if that source is for all practicable purposes inexhaustible, he is simply forced to abandon his located line. The appliances of modern engineering are now so vast in power and adaptability to work that in most cases man will conquer in the face of seeming impossibilities; but he can only accomplish this by the aid of capital equaling in extent the difficulties to be overcome, and by the patient expenditure of time as well as money.

In all important works, embracing underground excavation through strata the disposition and arrangement of which can only be more or less shrewdly guessed at, the probabilities of added cost and delay must be well discounted; a neglect of this precaution in dealing with the most important unknown factor in the problem will nearly always cause disappointment, and may entail disaster and ultimate failure.

Under conditions such as cited, the safest rule for guidance to the engineer is to be "prepared for the worst;" this implies an extensive outlay for plant which may not be required, but if it is needed it is there to meet the enemy; if not needed, the interest upon that plant is simply an insurance paid for safety.

As modern examples of the uncertainties of preliminary investigation we might mention the experience of the engineers at the Dorchester Bay Tunnel, near Boston, in this country, and at the Severn Tunnel in England.

At Boston, neither money, time, nor practical skill was spared in obtaining the borings that were to show the arrangement of strata and material through which the tunnel was to pass. The result of these borings exhibited a thick and apparently impervious stratum of tough clay immediately overlying slate rock, and separating this rock from the ocean overhead. The geologist foretold that this rock was broken by a vast settlement or disturbance in the ages past, but saw no practical danger from an influx of water. The actual condition of affairs was very materially different, and the estimated cost based upon the chart as shown was overrun by actual cost nearly one hundred per cent. The clay was not impervious but was interstratified with seams of sand carrying water; the clay covering was not continuous over the rock; and lastly the "rock" reported at a certain depth was *not* rock, at least as was implied, but the top of a heavy stratum of bowlders, sand and gravel, which was in direct communication with the sea, with an exposed area unknown in extent, and in itself a perfect reservoir of water under a head of 150 ft., ready at all times to feed the numerous seams in the disturbed slate rock below, through which the tunnel was excavated.

At the Severn Tunnel, with similar, or even more elaborate preliminary investigation, the workmen have been within the last two weeks driven out for the second time by an influx of water. The first flooding was in 1879, and the tunnel was only regained after a vast expenditure of money and time in equipping the works with a pumping plant of enormous capacity, and only after the surrounding country was so thoroughly drained that the land springs went dry. Since that time great progress had been made and communication practically established between the two ends of the tunnel; but two weeks ago, upon resuming work near the location of the old spring of 1879 another outburst occurred even greater than the first, pouring in with a volume four times that of the original flooding. The tunnel is now flooded, and six pumps are steadily at work, with a combined capacity of three times the power used in draining the surrounding lands in 1879, and as yet no gain can be reported. The old spring ceased running as soon as the new one was tapped, showing a connection between the two.

Returning to the Croton tunnels, the conditions will not be, of course, exactly similar to those cited, but the warning will apply as well, and the difference may be only one of degree. From the length of excavation, however, in the aqueduct tunnels the ultimate increased expense, if any heavy bodies of water are met with on the underground line, may reach a very respectable total, a figure that would materially affect the ultimate cost. Make allowances for the possibility in your estimates, Messrs. Engineers.

THE PANAMA CANAL.

From the last number of the *Bulletin du Canal Inter-Oceanique* we learn that the cube of material moved upon this work in the month of September was 310,000 cubic yards, or nearly 2,000,000 cubic yards moved in total to Oct. 1. The Huerne dredge has been at work since Oct. 8 at the mouth of the canal; about 5,330 cubic yards are excavated by it per day.

M. de Lesseps announces officially that the 600,000 obligations called for upon Oct. 3 had been met in full by subscribers by Oct. 8. In the name of the counsel of administration and for himself he thanks the public who have so promptly responded, and states that this subscription assures the rapid completion of a work destined to realize, in its turn, all the promises of Suez.

Chief Engineer Dingler, in his official report to the Superior Consulting Commission on Works, calls the attention of this Board to the following points now demanding definite decisions:

1. The Revisions to be made on some part of the line.
2. The fixing of the bed of the canal; taking into consideration, the conditions of discharge on the Pacific coast.
3. Arrangement of the Port at Panama.
4. Arrangement of the Port at Colon.
5. The management of the fresh waters.
6. The great cut at Culebra.
7. The route of the railroad at San Pablo and at Pedro Miguel.

Mr. Dingler concludes his report with the following recommendations:

1. The definite adoption of the line as shown on plan submitted.
2. To decide upon the establishment at Panama of a lock with three openings, each 82 feet wide, and long enough to permit the lockage of vessels 600 feet in length.
3. To approve of the arrangements for the ports of Panama and Colon as shown on map submitted.
4. To control the river waters by creating in the upper valley of the Chagres a reservoir of 1,330,000,000 cu. yds. capacity, by means of a dam constructed from the rock excavated and provided with an overflow of substantial construction so proportioned as to reduce the flow from the greatest floods to about 533 cu. yds. per second; and to construct a canal for carrying off this surplus parallel to the navigable canal.
5. To approve the measures already planned for the excavation of the great cut at Culebra.
6. To decide upon a location for the two drawbridges where the Panama Railroad crosses the canal.
7. To decide upon the construction of a great depot about midway on the line of the canal.

At the meeting of Oct. 2 the Commission approved without change and unanimously the recommendations of the Chief Engineer as outlined above.

THE STREETS OF ST. PAUL (MINN.).

An engineering correspondent of the St. Paul and Minneapolis *Pioneer Press*, taking as a text some remarks of our own in ENGINEERING NEWS of July 7 and 28, pungently criticises the present management of the street-paving department of St. Paul. The writer evidently knows whereof he speaks, and our own observation carries out the justice and truth of his remarks.

Both St. Paul and Minneapolis are almost phenomenal in their growth; the people of both cities seem very much alive to the requirements of progress, as exemplified in handsome and costly public buildings, in their manufacturing and railroad interests. But their lack of system and enterprise in the requirements of sanitary engineering in their streets and sewers still remains a reproach to them.

As clearly shown by the writer of the article, the present practice of street-paving in St. Paul is bad—could hardly be worse, in fact; all the rules laid down by the authorities seem to be outraged, and the result is what might be expected from the method, or rather lack of method, adopted.

Well-paved streets and a properly constructed system of drainage are necessities in a modern city. Public health and comfort demand both; and the city authorities who are not alive to this fact need replacing by abler and more progressive men. In St. Paul the parties responsible for the present mismanagement most emphatically misrepresent the people, who in themselves cannot be accused of lack of progress. It is evident that they have among them men who know better and can appreciate the blunders now being made. We trust that their blunders may be corrected before the inevitable day of reckoning comes with its train of disease, and a halt in the material progress of the people so careless of the simplest requirements of engineering and sanitary science.

THE COUNCIL BLUFFS WATER-WORKS.

These works are rapidly approaching completion under the supervision of Henry Birkinbine as Engineer. The conduit leading from the Missouri River to the subsiding basins is boxed for a distance of 1,200 ft., the remaining portion is in open channels. Two Andrews centrifugal pumps of 90,000 gallons capacity each per minute, pump the water from the well at end of conduit into the subsiding reservoirs; they are propelled by two Westinghouse engines. The clean-water pumps are two Knowles compound-duplex pumps of 6,500,000 gallons per day. These pumps force the water into the storage reservoir at the head of Glen Avenue. Four 100 horse-power boilers supply the steam necessary.

The two subsiding basins have a capacity of 11,000,000 gallons, and are now ready for water. Of the distributing system in the city less than 2,000 ft. remains to be laid.

THE PROPOSED JORDAN CANAL.

A correspondent of the N. Y. *Herald*, Gen. C. G. Gordon, of the Royal Engineers, contributes some interesting details in relation to this latest canal project.

In answering the objections made that by the construction of this new thoroughfare a vast area of fertile country would be swamped, he says that the section affected, though fertile, is so unhealthy that no European can live there except for two months of the year. It is nearly desolate, owing to the conditions named, and to the presence of bands of prowling Bedouins.

On the other hand, such a canal would give access to Moab and Ammon and the fertile lands between the Jordan and the Dead Sea and the Euphrates; and by means of Lake Huleh get ships within 50 miles of Damascus.

The following historical sites would be lost: Bethsaida, Capernaum, Tiberias, Plain of Gennesaret, Jericho and the Jordan River.

The Jordan fresh water could still be utilized for the water supply of all Palestine if desired, as the main source, Banias, is 1,880 feet above the sea. The population of Palestine inclosed by the canal would be 133,000. Area, 10,000 square miles, not counting the Sinai part, which is desert. Revenue, $800,000, of which $450,000 goes to Stamboul as "backsheesh."

Palestine would be isolated by the canal, and a State neutral to all the Powers could easily be constructed; and the canal would also cut off the hordes of robber Bedouins. The canal would be so wide that it could never be interfered with.

The cost is estimated by Gen. Gordon as follows:

For canal between Haifa and Jordan (Zerin), twenty-five miles	$15,000,000
Port at Haifa	5,000,000
For canal between Akabah and Ain Gherundel (forty miles)	35,000,000
Port at Akabah	2,500,000
Compensation to people of Jordan Valley	5,000,000
Backsheesh to Sultan	5,000,000
Total	$67,500,000

The quantity of water required to fill the canal and its basin is "325 cubic miles." It would take nine months to fill it if run from both ends, and twice that from one end through canals 180 ft. wide at bottom and 9 ft. deep. As for evaporation, as soon as the level of the sea is reached this would be no more than in the Mediterranean. The soil of the Arabah Valley is marl and soft rock. That of the Sidraelon plain is alluvial. The Gulf of Akabah is 200 ft. deep close to the shore.

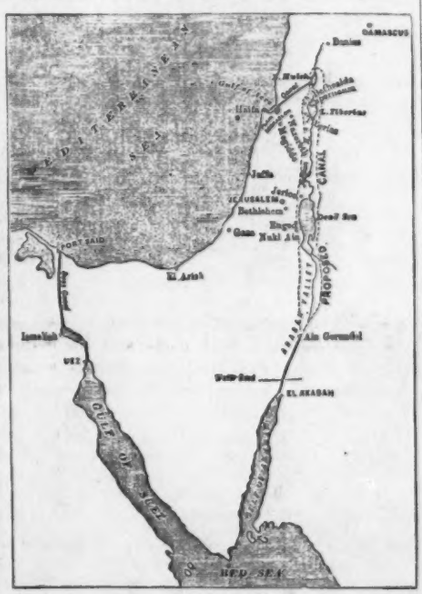
In discussing this project the advantages of the Jordan Canal, as over the Suez, are classified as follows: That from its width ships could traverse it at full speed, instead of crawling along at the rate of four knots per hour. The saving would be in time, fuel, wages, wear and tear, etc. With a canal at the cost estimated rates could be reduced from ten francs to two francs, and a large profit still realized.

The project is stated as presenting no great engineering difficulties, though the successful working of the scheme would require large capital, backed by engineering skill and experience.

The present population of Damascus is put down as 110,000, and with a railroad of fifty miles connecting it with the new sea, and the protection afforded from robber bands, the fertile and bounteous resources of the country could be utilized.

The formidable work would be in the elevated Arabah Valley, 110 miles long, and extending from the Dead Sea to the Akabah arm of the Red Sea. The cutting would be 67 miles long—27 on the northern, 40 miles on the southern slope; and the total length of the canal would be 240 miles, including the two lock cuttings, one of which would be 26 miles long, with a maximum depth of 285 ft.; the other 67 miles, with a maximum depth of 728 ft.

How far tunnels might save excavation was a question for engineers. For 147 miles the channel would be an inland sea about ten miles wide, except that for eleven miles it would be three miles wide. The water would be brought to within ten miles of Jerusalem, and Tiberias would be submerged. Its Latin convent and 497 houses could be replaced by a new town on an eligible site. The Jordan Valley contains eight or ten groups of squalid hovels, with about as many hundred inhabitants. It was very unhealthy and for the most part uncultivated, and the inhabitants were a sickly race. Jericho had sixty families of evil repute in wretched hovels. Other places consisted of sixty or seventy mud huts and ruins.



PLAN OF THE CANAL.

Map showing the cutting from the Mediterranean to the Lake of Tiberias, the Jordan Overflow, and the Canal to the Gulf of Akabah.

The Rev. Canon Tristram, of England, in a late controversy, objected to the scheme for several reasons: it would bury forever 2,800 square miles of rich soil, and the site of some of the greatest events in the world's history; it would extinguish a now unique fauna found nowhere else. He stated that it was difficult to estimate the cost of the work, and puts down the mean cutting from Acre at 200 ft. in depth for 25 miles, costing at the rates established at the Suez Canal, £2,500,000 per mile. He says from Arabah to the Red Sea for 70 miles the mean cutting would be 450 ft., and concludes by figuring the probable cost per mile as being thirty-two times that of the Suez Canal.

As the project stands at present, the unknown, or at least disputed, quantities are the amount of money the canal would really cost, and the length of time required to fill this depression in the earth's surface with water, when the ditches were completed. General Gordon says it could be filled from both ends in nine months; the objectors say that owing to evaporation, percolation, etc., one hundred years would hardly bring the new sea to the level of the Mediterranean with supply-channels of 15 ft. by 150 ft., and an entering stream with a velocity of 25 miles per hour. Closer investigation is evidently needed before any definite conclusions can be arrived at.

THE WORKS AT EMPERADOR, ON THE PANAMA CANAL.

(*See opposite page.*)

The accompanying sketch, reproduced from a photograph will give some idea of the extent and importance of the work now going on at this point.

Emperador is a station on the Panama Railway, and lies on the Atlantic slope of the Culebra or Great Cut, it is about 31½ miles from Colon.

These excavations, under the direction of a former Suez Canal Engineer, Mr. Jaquemin, are, as shown, being worked in several benches simultaneously. A number of excavators are in use here. One class of these machines removes the earth lying above them, scraping it down, in fact; another type excavates the material lying below its platform; the main difference being in the direction in which the chain of buckets moves. The machines of the first class works upon the upper benches, the others in the bottom of the excavation.

Two locomotives and trains of wagons are detailed for each excavator for removing the material, which is carried towards Matachin there to be placed in the Gamboa dam.

During the month of August last, notwithstanding the heavy rains, 15,330 cu. yds. of heavy material, and about 31,000 cu. yds. of smaller material was removed; the latter being nearly all rock.

The section of Emperador operates about 3,700 linel feet of railroad track, and uses 176 large cars.

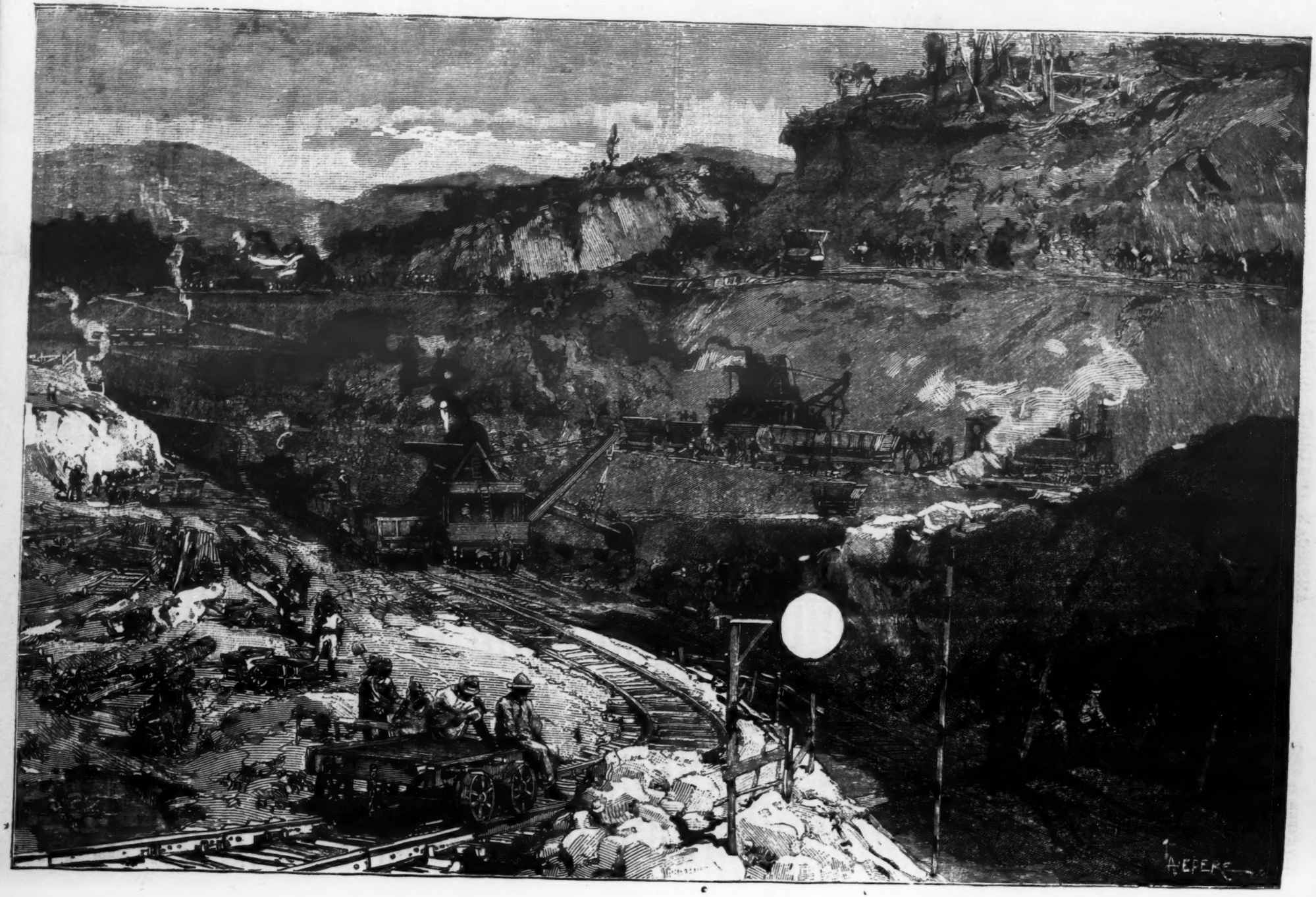
THE HASKELL MULTI-CHARGE GUN.

The experiments now being made at Sandy Hook with the multi-charge gun, invented by Mr. J. R. Haskell, have, so far, proved satisfactory to all parties interested.

The gun, briefly described, is 25 ft. long over all, with a bore 6 in. in diameter, and a total weight of 25 tons; it is breech-loading. The four pockets ranged in a line on the underside of the gun, for the discharge of supplemental charges of powder, make the distinctive feature of this new weapon of war. The lining of the gun and the pockets is of steel, the outside covering is iron. The pockets are each 22 in. in depth, with a maximum inside diameter of 11¼ in.; and the axial lines of the pockets intersect the axis of the gun at an angle of 55°, pointing toward the mouth of the gun; the width of the throat of the pockets where they open into is 4 in.

The purpose of Mr. Haskell, in designing this peculiar gun, was to enable him to utilize a much larger charge of powder than is possible with a single charge gun, and to project with a greater velocity a heavier shot than is ordinarily used with the calibre adopted. With the single charge, the full power of the gases is developed at once and near the breach of the gun, before the shot has fairly started upon its way; and the projecting force of the charge regularly decreases as the projectile travels toward the muzzle of the gun. By this action the greatest strain is exerted at the breach of the gun, and with a large charge this strain becomes enormous in amount, running up to 100,000 lbs. per square inch, and can only be met by mass and tenacity of material used in the guns.

The theory of Mr. Haskell's invention is the gradual accumulation of power by the successive explosion of separate charges behind the shot as it traverses the bore. A charge of slow burning powder in the breech overcomes the inertia of the shot and starts it on its way, and this shot receives an additional impulse from the explosion of each of the four supplemental charges, as the passage of the shot forward exposes to the burning gases the powder in the pockets. The objection was originally made that these supplemental charges could not be exploded with sufficient rapidity to exert any effective power upon the moving shot. Both theory and practice have proven the fallacy of this objection, for the velocity of expansion of gunpowder has been found to equal 7,000 ft er



second, and it is impossible to impart anything like the same velocity to the projectile. The claim of the inventor is that he will gain 50 per cent. in velocity and range, and 100 per cent. in penetration, over guns built upon the old system.

The practical results of the present experiments can be briefly summed up from a late authoritative article appearing in the New York *Sun*. Twenty rounds have been fired to date, the first seven being purely experimental; first, to test the gas-check ring which follows after the shot, and must necessarily absolutely prevent the escape of the burning gases ahead of the shot; this ring is made up of discs of copper and sole leather and was found to be perfectly reliable, the next step being the selection of such grades and quantities of powder for the initial and supplemental charges as would maintain as near as possible a uniform pressure of 20,000 lbs. per square inch throughout the bore of the gun. These details having been satisfactorily fixed, the test firing for actual pressure and velocity was commenced with the results given below:

ROUND.	Weight of shot.	Weight of powder.	Av. pressure, lbs. per sq. in.	Velocity, ft. per second.
9	108	47	20,800	1,514
10	110	50	20,600	1,558
11	109	49	20,900	1,554
12	106	66	20,400	1,673
13	109	83	20,200	1,735
14	110	86	19,800	1,761
15	110	86	19,600	1,732
16	110	86	19,400	1,757
17	72	95	21,000	2,051
18	71	96	21,100	2,101
19	111	87	21,200	1,832
20	110	87	19,700	1,791

To further describe the details of the gun we should mention that the bore is rifled with fifteen grooves, each $\frac{1}{150}$ of an inch deep, and with one twist in twelve feet. The shot is a conical iron shot, banded with copper, to take the rifling; the shot, gas-check ring and starting charge are put into position from the breech of the gun. The four pockets are loaded by first unscrewing steel plugs on the upper side of the gun and in line with the pocket; the powder is then poured in loose through a copper funnel; 18 pounds of powder were used in each supplemental charge and 15 pounds at the breech, in Round No. 20 as tabulated above. The powder in the four pockets is graduated in size from grains the size of peas, nearest the breech, to ordinary musket powder in the last pocket. As the finer-grained powder will burn more quickly, this disposition of grades meets the requirement of proportioning the time consumed in the combustion of the powder to the swiftly accelerating speed of the moving projectile.

CORRESPONDENCE.

FORM OF NOTE BOOK.

NORWICH, Conn., Oct. 15, 1883.

EDITOR ENGINEERING NEWS:

In response to Mr. Burr's letter in your paper of Sept. 1, I offer for criticism the following plan, which is, with some modifications, the one I use for keeping field-books.

1. Note-books five inches wide, seven inches high, with 64 pages each. This is about as large as is convenient for the pocket, and the number of pages sufficient for most ordinary surveys. For more extended surveys a number of books can be used, and an assistant can use the first book in mapping, while the survey is being continued in others. A number of short surveys may be put in one book.

2. The paper of which the books are made, ruled one-fifth of an inch apart each way with faint lines. Every fourth vertical line to be of a different color, and the central one a double line.

This double line represents the transit or base line, and all objects to be located are sketched in with the aid of the faint lines and the locating measures written in their proper position. When used for leveling, the columns made by the second color give room for Sta., B. S., F. S., Diff., Elevation and Grade on the left-hand page, and the first two columns on the right-hand page may be used for Cut and Fill, if desired, the remainder being used for explanations.

3. The books, and the pages in each book, numbered.

4. The name of client in private work and the name of street in city work, and such additional matter as will identify the survey, together with the date of survey and page on which it begins written plainly on outside of cover and on first page.

5. A general index, in which the name of client or street appears alphabetically, with explanations, date of survey and book and page.

6. Books kept in drawers eight inches deep, with portions five and one-half inches apart, between which the books stand leaning from you, with the numbers facing you in regular order. At every twenty-five books a card one-half inch higher than the books should be inserted, with the number of the following book printed at its top.

The above outlined method is designed for city and general variety work.

Yours respectfully, C.

OBITUARY.

MR. A. C. DE MERRITT of the Department of City Works, Brooklyn, died on October 31, from malaria contracted in the line of duty. Mr. De Merritt was born about 1834; years ago he was employed as an engineer in the Brooklyn Navy Yard, and afterward became Assistant Engineer of the Brooklyn Water-Works under Chief Engineer Julius W. Adams. Upon the reorganization of the Brooklyn department he was put in charge of the Street Department and remained in that office until his death.

PERSONAL.

Captain JAMES B. EADS sailed by the Oregon on the 24th ult. for Europe.

W. N. MONROE, who is building a road in Mexico, was lately at Eagle Pass, Tex.

MR. RICHARDSON, contractor of the Laredo (Tex.) water-works, left there lately for Boston.

R. H. LEE, Chief Engineer of the Duluth & Iron Range Railroad, was lately in Minneapolis.

HUBBARD & MCBAIN have 75 men at work, quarrying for a $60,000 stone contract for Omaha.

MR. GASLEY has been nominated as Surveyor for Wyandotte County, Mo., by the Republican party.

CHIEF ENGINEER BARCLAY and the surveyors of the M. S. W. C. Ry. are encamped at a point 20 miles due north of Manitoba City.

R. MONTFORT, Chief Engineer of the Louisville & Nashville, is on a tour of inspection of the bridges on the North and South Alabama roads.

LIEUTENANT C. J. BAILEY and J. S. OYSTER, of the United States Army, were lately in San Francisco from a surveying expedition in the North-West.

MR. J. M. WILLIAMS, lately of the engineer corps of the Gulf, Colorado & Santa Fe road, has been appointed General Superintendent of the Texas Trunk.

A CONTRACTOR who is laying sewers in Waterbury, Conn., cut down the wages of his Italian laborers from $1.50 to $1 per day. This resulted in almost a riot.

MR. ANDREW ROSEWATER, Mem. A. Soc. C. E., City Engineer of Omaha, Neb., was married on October 18th at Omaha, to Miss FRANCES MEINRATH, of Boston, Mass.

MR. WILLIAM H. BROWN, Chief Engineer of the Pennsylvania Railroad, has returned from Europe, much benefited by the period of rest he has had from his arduous duties.

MR. VANZILE, of Winnipeg, has been retained in connection with the Manitoba Southwestern Railway under its new management, as superintendent of construction as well as operation.

MR. D. P. BRUNER, M. Am. Soc. C. E., has resigned his position on the South Pennsylvania R R. to take the position of manager of the branch office of the Durham House Drainage Company in Philadelphia.

MR. CHARLES FAIRBAIRN, a mechanical engineer of Manchester, England, a relative of the famous engineer Sir WILLIAM FAIRBAIRN, was in the city recently. He has gone to visit friends in Canada, and expects to spend a few weeks in the United States. He is the inventor of a machine for making screws by rolling hot.

GEORGE M. DAWSON, son of Principal Dawson, of Montreal, and a member of the Dominion Geological Survey Department at Ottawa, returned lately from a four months' exploratory tour of the Saskatchewan and Bell River coal regions, as well as a survey of the Rocky Mountains. Mr. DAWSON has for several years been engaged in making exploratory surveys of the Northwest.

MR. SHIELDS BURR, Civil Engineer, of Laurel Mills, Prince George's County, Md., formerly Superintendent of the Southern Maryland road, died Sept. 6 last, of yellow fever, while on his passage from Guaymas to Topolobampo, Mexico, and was buried at sea. Mr. BURR left Washington on Aug. 6 last, in charge of a party of engineers, to locate the line of the Mexican & Pacific Railroad from Topolobampo eastward.

C. E. MERRIAM, Memb. Eng. Club of Phila., "makes the chips fly" as follows: On the 6th day of September (the anniversary of loss of bridge last year) the Mexican National Railroad bridge was carried away by high water. On Monday, the 16th Sept., the first pile was driven for the new structure, which was completed on the 23d, and trains are now running regularly. This is pretty quick work—the erection of a bridge 600 feet long in *seven* days.

MR. THOMAS J. SEELEY, Assistant General Superintendent of the Sonora Railway, died Oct. 1 while on his way from Mexico to his father's home in Oswego, N. Y. He was 37 years old, and his death was caused by consumption. Mr. SEELEY graduated from the University of Michigan in 1869, and became a civil engineer. He was employed as Assistant Engineer on the Atchison, Topeka & Santa Fe for nearly six years, and went to the Sonora road about a year ago.

THE New Orleans *Times-Democrat* says: "The many friends in this city of Col. GEO. H. HAZLEHURST will be pained to hear that he is still very dangerously ill at his residence in Chattanooga. Col. HAZLEHURST is one of the most prominent railroad contractors and engineers in the country, and had charge of the construction of the "Big J" road many years ago. For over four weeks he has been suffering from a malignant attack of swamp fever, and at present there is but little hope of his recovery."

JOHN W. MACKEY said to a reporter: "Mining is the most precarious business in the world." "You can well afford to say it," the reporter retorted, "with $30,000,000 in your credit. But did you think so in 1869, when you were pushing an ore car in the Ophir mine?" "I knew it then only in theory; for my salary of $4 a day was always sure, and my wants were simple. You always hear of the successful miners. The men who disappear and are lost in Pauper alley are not so often quoted."

THE Springfield *Republican* says: "WILLIAM HOOD, the oldest son of the late JOSEPH E. HOOD, who was for many years an assistant editor of *The Republican*, has recently been appointed Chief Engineer of the Central Pacific Railroad and its branches. It is seventeen years since Mr. HOOD entered the service of the Central Pacific as a civil engineer, and during this period he has occupied various responsible positions. For some time past he has been Chief Assistant Engineer of both the Southern and Central Pacific roads, and he located the whole of the former line, including the famous Tehichipi loup, which he considers his greatest engineering feat. His headquarters are now at San Francisco."

CIVIL ENGINEER MENOCAL, of the navy, has been granted a year's leave of absence to go abroad.

During the period of his leave Mr. MENOCAL will take part in superintending the arrangement of the Panama canal under DE LESSEPS at a salary of $10,000 per annum. Besides the above compensation he will, under the regulations, draw three-fourths pay as a civil engineer of the United States navy. Mr. MENOCAL'S good fortune is said to be due to the influence of Admiral AMMEN. The latter, it is true, represents a large interest in the Nicaraguan canal, which is known to be in direct opposition to DE LESSEPS' scheme, but as the latter appears to be making but slow progress and DE LESSEPS is going ahead briskly he could not offer any objection. Mr. MENOCAL personally surveyed the proposed route of the Nicaraguan canal, and also went over the ground upon which DE LESSEPS is now operating.

THE NEW SUPERVISING ARCHITECT.—WASHINGTON, Oct. 30.—Secretary FOLGER to-day appointed MIFFLIN EMLEN BELL, of Des Moines, Ia., to be Supervising Architect of the Treasury, instead of J. G. HILL, resigned. Mr. BELL was architect of the Capitol buildings at Springfield, Ill., and Des Moines. MIFFLIN E. BELL, the new Supervising Architect of the Treasury, is a native of Chester County, Penn., and is 36 years old. He studied his profession under some rural builders, and was a member of the force of A. H. PIQUENARD, of Chicago, the architect of the Illinois and Iowa State-Houses. As foreman he was given charge of the detail work of both. After PIQUENARD'S death Mr. BELL'S design for the prison at Chester, Ill., was chosen, and he took charge of its completion. It is thought that W. F. HACKEY, Mr. BELL'S partner, will take charge of the Iowa Capitol until its completion.

A good story is told of the well-known engineer WILLIAM A. SWEET, of Syracuse. Casually meeting a prominent lawyer one day a brief conversation ensued, in the course of which Mr. SWEET happened to ask "the judge" what he thought of some question they were discussing, without really meaning to ask legal advice in the usual way. Soon afterward Mr. SWEET received a bill from the judge, "for legal advice, $1,000," which he paid promptly without a word of complaint.

Time passed on, and one day the judge, who was also heavily interested in salt manufacture, needed some mechanical advice about some machinery, which was not running satisfactorily, and asked Mr. SWEET to look at the machines and tell him what was needed. Mr. SWEET looked them over for two or three hours, and indicated the cause of the trouble. When he went home he promptly made out a bill against the judge for "mechanical advice, $1,500," and the bill was duly paid, furnishing probably one of the few instances on record in which mechanics ever got ahead of the law.—*American Machinist.*

THE NICARAGUA CANAL.

Among the points agreed upon by the Nicaraguan Congress in regard to the canal are that the government of Nicaragua be authorized to unite with the other republics of Central America in guaranteeing that the net profits of the Nicaraguan Canal shall never amount to less than three per cent. on the capital employed in its construction, and which shall not exceed $75,000,000, and that this guarantee shall last twenty years from the date on which the canal shall be completed and opened to traffic. The government is consequently authorized to guarantee a profit of three per cent. net upon $20,000,000 of capital fixed by the previous article, either in association with the other governments, in the event of their guaranteeing the same rate of interest on the remainder of the capital, or singly, should the others not agree to act; but it must be stipulated that the expenses of construction and maintenance shall not exceed $1,000,000 annually, and that any deficit in the amount of profits which shall have been recognized and paid by Nicaragua will be returned by the company from any excess of profits which may be subsequently obtained over and above the three per cent. which is guaranteed.

The government will subject this concession of its guarantee to the conditions it may consider necessary to establish in favor of the Republic and in order to determine the actual cost of the canal and the amount of the profits.

NEWS OF THE WEEK.

THE JAMESTOWN (N. Y.) WATER SUPPLY company has begun to dig the trench between its reservoirs and the outlet in which the iron pipe will be laid to conduct water to the pumps in case of a great emergency (like a big fire), when the supply in the reservoirs would be insufficient to the demand.

THE JAMESTOWN (N. Y.) GAS-LIGHT COMPANY'S new holder was filled to its greatest capacity for the first time Monday, 29th ult., when it contained fifty thousand feet of gas. This holder cost over $12,000, and Superintendent A. F. Kent says it is the most satisfactory in its workings of any that he ever built. This is as it should be, because the company spared neither money nor time to construct a model holder.

The gas works made 170,000 ft. of gas between Saturday noon and Monday noon, and from Saturday noon to Sunday at 12 m., 86,000 ft. were made. This is the largest amount manufactured since the works were built. About 54,000 ft. of gas are used every twenty-four hours at present, and this amount will be increased until at the holidays the nightly consumption will be 80,000 ft. or over. It is safe to say that there are few gas companies in the country which give better service or which own more completely equipped works than that doing business under the name of the Jamestown Gas-Light Company. The new gas holder is 18 ft. by 60 ft., and was built by the Kerr Murray Mfg. Co., of Fort Wayne, Ind.

THE presence of surveying parties is always one that greatly exercises the rural mind, and the theodolite during the early railway epoch was looked upon with superstitious, not to say suspicious, feelings. Corrollton County, Illinois, is "full of surveying parties who are running lines in all directions." A local paper says:

"Besides the C., B. & K. C. party, who are 'setting grade stakes' on the line from Sumner to Carrollton, another party has been at work, apparently, on a line from Lexington to Chillicothe; still another further west, near Richmond, heading this way; while there are rumors that the Wabash will change their line between Brunswick and Carrollton, leaving the bottom route out in the cold. We presume there is no truth in the Wabash rumor. They cannot afford to leave DeWitt, to say nothing of White Rock and Wakanda. The survey from Lexington to Chillicothe, or perhaps to the vicinity of Bogard's Mound, is probably an extension to the old Lexington, Fort Scott & Gulf Road northward to Chillicothe, in the hope that either the C., R. I. & P., or the C. B. & Q., or the C. & N. W., will buy them out, and thus get a line into the Southwest. In either case Carrollton is not hurt."

The only apprehension how seems that of "being left out in the cold" by the surveying corps.

ANOTHER NEW RAILROAD.—"What are you going to do in Chicago?" Mr. S. F. Scott was asked as he boarded the evening train for the city of sin.

"See about building a new railroad."

"What railroad?"

"We haven't named it yet."

"Where will it run?"

"From Kansas City to Excelsior Springs."

"A branch connecting the springs with the main line of the Wabash, or the Hannibal & St. Joseph?"

"No, indeed. It will be a great through line."

"What are the prospects of its being built?"

"There are no prospects about it. It is a dead sure thing, and don't you forget it, young man."—*Kansas City Times.*

THE contract for bridge over the Osage River (Kan.) has been given to Carlson & Curns, of Fort Scott.

THE ONTARIO & QUEBEC RAILROAD.—This line is being rapidly constructed, and freight can be carried from Montreal to Toronto by Christmas. It is said that the whole road from Toronto to Montreal, including rolling stock and the ninety miles to be built east of Smith's Falls, will cost $9,000,000.

MR. ELIOT C. CLARKE, of Boston, has been examining, along with a committee, the route for the North River sewer, Salem, Mass.

THE Opossum Levee Contract has been awarded to Robert Johnson, of Memphis, at 20 cents per cubic yard for earthwork and $35 per acre for clearing.

AN engineering party from Winnipeg is to survey the Rapid City Central—a line running from Brandon to Fort Ellice.

THE steel bridge to be built across the South Saskatchewan, at Medicine Hat, Manitoba, this coming winter, is 900 ft. long, 36 ft. above low-water mark. It is to rest on six piers and two abutments, and is to contain a swing between the the first and third piers. About fifty men are at present employed, but this force is to be increased to upward of two hundred. 1,000 car-loads of stone will be required for the piers. Mr. Thomas Watts is superintendent for the contractor, Major Bowles, of Winnipeg, while J. H. Armstrong performs a similar duty for the N. A. C. Co. The cost will not be far short of $250,000.

AGAINST A BRIDGE.—A firm of ship-owners in Chicago has filed a bill to prevent the Chicago & Evanston Railroad Company from building a bridge across the north branch of the Chicago River, on account of its being an obstacle to navigation. Some statistics of the traffic over the Pivot bridge were given for the month ending Sept. 13. It was turned for the passage of vessels 1318 times and some 105,000 vehicles crossed over. During the same time there crossed over the Chicago & Northwestern Railway bridge 9,918 engines, 3,028 passenger trains, 22,996 passenger cars, and 21,083 freight cars. The bridge was open 1,758 times for vessels.

THE UTICA WATER SUPPLY.—Engineer John C. Campbell has found a feasible route for bringing water from the West Canada Creek to Utica. The highest point in Utica was found to be 220 feet above the level of the Mohawk. The distance of the reservoir from the city, the length of the pipe to be laid and the cost of bringing the water to the city are points concerning which no estimate has yet been made. The cost of the survey was only $497.40, exclusive of Mr. Campbell's charges.

THE St. Louis Board of Improvements will make its own macadam in future.

THE St. Joseph & Rio Grande Road is now surveyed 200 miles in a southwesterly direction.

THE preliminary survey of the Franklin & Somerset Railroad has been commenced. Colonel Wildes, of Skowhegan, will begin at South Strong, and Engineer Thompson at North Anson, assisted by John Clark, of North New Portland, will begin at North New Portland.

COLLAPSE OF STEAM-HEATING IN TROY.—The property of the Steam-Heating Company, constituting the plant of the works on River street, the radiators and about five miles of pipe, was sold at auction this morning, says the Troy *Press*, in front of the court-house by Harvey J. King, referee in foreclosure proceedings. The property was sold to John L. Russell for $15,000, subject to about $3,000. The steam-heating works have been an extensive "white elephant," having cost, it is said, $225,000. Mr. Russell will take charge of and run the works at the expiration of the lease on May 1, 1884. The works will be run this winter. It is believed that for next season's operations a new company will be organized.

THE Oneida, N. Y., water-works were opened on Oct. 27.

NEW BRIDGE.—Notice is given by the Commissioners of Cuyahoga County, Ohio, of their intention to build a bridge across the Cuyahoga River, near the twelve-mile lock, Independence township.

Petitions for or remonstrances against said improvement will be heard by the said Commissioners on the fifth (5) day of November, 1883.

NEW RAILROAD.—ERIE, Pa., October 30.—During the latter part of last week some of the most prominent railroad men and railroad lawyers in the country met in Erie and reorganized the old Erie Canal Company for the purpose of effecting a railroad combination between New York, Philadelphia and Baltimore by constructing a railroad on the old abandoned canal bed to connect with the Baltimore and Ohio and Reading railroads, thereby giving an outlet to Lake Erie and the trade. The reorganization was effected secretly and every precaution was taken to guard against publicity.

KEELY EXPLAINS AGAIN.—PHILDELPHIA, Oct. 30.—The Board of Directors of the Keely Motor Company held a meeting to-night. Mr. Keely made a statement explaining his progress, and stated that he was constructing a street chamber to contain the vapor, and that when this was completed an exhibition would be given. The directors voted Mr. Keely's explanation very satisfactory.

THE ARKANSAS LEVEE WORK.—NEW ORLEANS, Oct. 31.—According to the reports of the United States Engineers who have examined the site of the proposed levee work in Arkansas to close the Opposum Fork outlet in that State, by which a vast body of flood water is annually discharged into the Tensas basin. The embankment will require to be 16 miles long and contain 880,000 cu. yds. A contract for the work was let at Little Rock on the 20th of October by the Arkansas State Levee Commissioners. The price to be paid for it is to be 20 cents a cubic yard; the amount of embankment being estimated at 300,000 cu. yds., which would make the total cost $60,000, of which Gov. McEnery, of Louisiana, has agreed to pay $25,000, while the State of Arkansas is to pay $35,000.

According to the report of the Government Engineers the levee will contain 880,000 yds., which at the contract rate would cost $176,000. In the light of these reports it would appear that the $60,000 promised by the State of Arkansas and Gov. McEnery will not be half enough to finish the work. Gov. McEnery has assumed the responsibility of promising $25,000 to the construction of the levee in Arkansas, on the faith, doubtless, of having the money refunded from the Louisiana Treasury by act of the Legislature. At present he appears to have no authority to pay money out of the treasury to build levees outside the limits of the State.

RAILWAY INTERESTS.—It is stated that a new road has been nearly completed connecting the Lake Erie & Western with the Alton & Terre Haute, forming with the Nickel-Plate a new line from Buffalo to St. Louis.

The Nashville & Florence road is now completed to Lawrenceburg, Tenn., fifteen miles beyond the late terminus at Stewart and thirty-five miles from the junction with the Louisville & Nashville at Columbia.

Surveys are being made for a railroad from Rising Fawn, Ga., on the Alabama Great Southern road, northward to Coal City, about 18 miles. It is intended to give the coal mines about Coal City a new outlet southward.

The St. Louis & Dakota company has been organized to build a railroad from New London, Mo., on the St. Louis, Hannibal & Keokuk road, through Iowa, Minnesota and Dakota, to some point on the Northern Pacific. The projectors are trying to secure subscriptions in St. Louis.

The Baldwin Locomotive Works have recently received an order for sixty locomotives to go to South America.

For the month of September and the nine months then ending the exports of steel and iron rails from Great Britain to the United States and to all countries are reported as follows by the Board of Trade, in tons of 2,240 pounds:

To United	September			Nine Months		
States:	1881.	1882	1883.	1881.	1882.	1882.
Iron rails.....	5,922	103	50	83,593	20,916	2,569
Steel rails....	20,111	6,662	6,508	156,773	130,075	51,302
Total.	26,033	6,765	6,558	240,271	150,991	53,871
To all C'tries:						
Iron rails.....	8,496	2,621	1,100	101,236	40,580	20,232
Steel rails....	60,631	47,538	63,242	450,924	552,555	579,421
Total.. ...	69,127	50,159	64,342	552,160	593,135	600,623

Thus the total exports are 28 per cent. more than last year in September, and 1¼ per cent. more for the nine months in spite of the large decrease in exports to this country. Canada, India and Australia have been the chief takers of British rails this year; 263,871 tons have gone to them, and 170,818 to unspecified countries, out of a total of 600,623 tons.

THE CANADIAN PACIFIC.—There are some fears as to the Canadian Pacific being able to find a practical crossing over the Selkirk range of the Rockies through Kicking-Horse Pass. No effort or expense to secure the shortest and best route across the mountain has been spared by the company, as it is well known that the company has been at enormous cost keeping engineers in the Rockies for two years making surveys and explorations with the view of securing the best route. At this late hour, when the track has been laid far up the Bow River Pass, to within thirty-five miles or so of the summit, it has been discovered that after all it may be impossible to cross via Kicking-Horse Pass. Engineers are on the work in dispute. Some claim that it is impossible to go that way and avoid the crossing of the range by Horne's Pass. In order to go via Horne's Pass it will be necessary to deviate considerably, and to do so seven or eight miles of track already laid would have to be lifted. The engineers could not come to any agreement, so they were all called in and the matter laid before the General Manager and other officials. When it was seen there was but little prospect of an agreement among the engineers on one route, and serious consequences might result from further prosecuting work this season, when it was not definitely known that the pass was feasible, it was deemed best to stop all work for two years, and orders were accordingly sent out to that effect. In the meantime the most efficient engineers will be put to work to ascertain the best route. Some 4,000 or 5,000 workmen have been dismissed and work stopped on all sub contracts.

AN engineer corps is busy with the survey of the St. Joseph, Joplin & Gulf Railroad, a narrow-gauge, which is run through Mexico.

TURNPIKE ROADS IN TEXAS.—It is proposed to construct 60 miles of road in the neighborhood of Dallas. The estimated cost is $5000 per mile.

WATER-WORKS VETOED.—The Mayor of Terrell (Texas), has vetoed the water-works contract.

INSPECTING PENNSYLVANIA LINES.—Superintendent Watts, Engineer Bennett, Assistant Engineer Loree and other officials have been examining the lines west of Pittsburgh.

MACON, Ga., is to have a property-book made and a map of the city drawn from actual surveys for the benefit of the Committee on Street Encroachments.

NORFOLK & WESTERN RAILROAD.—Earnings for September, 1883, show an increase of 32.1 per cent. over September, 1882, and 23.7 per cent. for the nine months over the same time in 1882.

A CONTRACTOR'S DEBTS.—The Baltimore & Ohio Railroad Company have just settled with the Northeast creditors of Dreisback & Wilcox, defaulting contractors of the new B. & P. Railroad, on a basis of 77 cents on the dollar.

BROCKTON (MASS.) WATER-WORKS.—The City Treasurer was authorized to borrow $8,000 for the purpose of extending the water mains and making additional service connection; also to borrow $2,500 for the completion of the Winthrop School; both of the above appropriations to be paid from the taxes to be assessed in 1884.

THE NEW NIAGARA BRIDGE.—The shore arms of the two cantilevers are practically completed, and on Oct. 26 the first segment of one of the river arms was lowered into place. One hundred and fifty men are now employed. Rapid progress is being made on the approaches.

OLATHE (KANSAS) WATER-WORKS.—Work on the impounding reservoir at Olathe, Kansas, is progressing favorably; the reservoir will hold about 20 millions of gallons; filter basin at outlet, capable of filtering 200,000 gallons per day; work is done by local contractors; engineer in charge, D. W. Pike; Consulting Engineer, G. W. Pearsons.

LEAVENWORTH SEWERAGE is being constructed on the Waring system. G. W. Pearsons, Consulting Engineer.

THE Connecticut Water Pipe Company, of New Haven, completed the laying of 26,791 ft. of water pipe on the 27th inst., connecting Lake Saltonstall with the mains of the New Haven Water Company in the centre of the city. The pipe used was the "Phipps Hydraulic Pipe" of 24, 20 and 16-in. diameter. The New Haven water company has now an additional supply of six millions of gallons daily. A Worthington pump of that capacity is used, forcing the water to a stand-pipe of 167 ft. elevation above mean high water, and it is conducted thence through a 24-in. pipe to a reservoir 10,000 ft. distant. New Haven, with a population of 70,000 inhabitants, has now a daily water supply of fifteen millions of gallons.

PUBLIC IMPROVEMENTS OF OMAHA.—This enterprising city, with a population rapidly approaching 60,000, has been especially active in public improvements this year. About $10,000 has been expended in sewerage; the Water-Works Company (a private corporation) has now about 38 miles of pipe laid; it has a very complete system of settling basins and distributing reservoir. The water-supply system is a combination of gravity and direct pumping—the latter being furnished by a Holly-Gaskill pumping engine; elevation of distributing reservoir, 305 ft. above river at a distance of 2¼ miles from the city; 220 ft. above business center of the city; 300 hydrants are in use. The gas-works have beensold to a Philadelphia company, who will hereafter manufacture the Lowe water-gas. Private business houses have adopted electric lights very generally. The A. L. Barber Company, of Washington, has a very large contract for Asphalt paving, of which about one-half is completed, the balance to be done next spring. Taxpayers pay for actual lot frontage in five annual installments, or they can commute. The city pays for the intersections in 6 per cent. twenty-year bonds. In street grading about the outlying portions of the city over $80,000 has been spent this season. The outlook for the next year is first-rate; wages are high, there will be contracts to be let, and the city is prosperous. Its bonds command a premium.

E. ST. LOUIS (ILL.) WATER-WORKS.—At a recent meeting of the Council, an ordinance was introduced by Mr. Sullivan granting a franchise to the owners of the St. Louis Bolt and Iron Mill to establish a water-works system and lay pipes for supplying the city with water, and to connect with the bridge company's pipes. After some discussion the ordinance was referred to the Committee on Streets and Alleys. A committee of four was appointed to examine the new plans for the proposed bridging of Broadway and Cahokia Creek. The committee was instructed to report as soon as possible.

BIG LIBEL SUIT.—The People's Railway Company of America on the 26th ult. commenced a suit in the Circuit Court against Wilbur F. Story, proprietor of the Chicago *Times*, for libel, placing the damages at $500,000. The action is based upon an alleged libellous publication which appeared in the *Times* Oct. 13, as follows:

"The People's Railway Company is as villainous a scheme as was ever concocted to rob poor, simple people of their money. Intelligent people stand in no peril from it. The fraud is too transparent. It is the ignorant and the poor whom it is designed to wheedle out of $25 each who are in danger."

The complainants allege that the company exists for lawful and laudable ends. They claim that the charges are utterly without foundation, and that the publication of the article greatly injured the company in the estimation of the public. The People's Railway Company is said to have been incorporated in Indianapolis in June last with the avowed purpose of constructing a double-track railroad from Oakland, Cal., to New York City, with capital stock fixed at $175,000,000. Local boards of directors have already been appointed at Chicago, Indianapolis, Lafayette, Louisville, San Francisco, Visalia, Fresno and other points in California.

LONDON, Oct. 25.—On the Stock Exchange, to-day, Canadian Pacific Railway stock advanced 10 per cent. upon the report that the Canadian Government had guaranteed 3 per cent. interest thereon for 10 years.

NEW WATER-WORKS ENGINE.—The Board of Water-Works Trustees, of Cleveland, O., held a special meeting on the 25th ult., for the purpose of awarding the contract for a new pumping engine at the West Side pumping station. They decided to purchase a Worthington engine of ten million gallons daily capacity for $94,000. It will be a duplicate of the two Worthington engines now in use, but will cost $13,000 dollars less than the first one purchased and $5,000 less than the second. But three engines were in competition—the Holly (Gaskill), Martin and Worthington. The price asked for the Martin was $47,850, and for the Holly $41,500.

RAILROAD WORK SUSPENDED.—Work on the Memphis & Holly Springs road has been suspended for several months, on account of failure to meet the payments due Colonel J. S. Hamilton, contractor. Thirty miles of the railroad was completed and about twenty miles of track laid. Hamilton has sued Fred Wolffe, the president, and the Water Valley (Miss.) *Progress* says: "The case will go to trial early in November. Efforts are being made to compromise, which, if effected, money will be raised to complete the road at once."

THE map and profile of the route of the New York, Danbury & Boston Railroad between Bronxdale, in Westchester, and the Connecticut line was filed, Saturday, the 20th ult., in the register's office at White Plains. The preliminary work in Connecticut is said to be going on rapidly.

WESTERN FREIGHTS.—All the roads running west of the Missouri River have united in the following circular to shippers.

1. Owing to the nature of grades, tunnels, snowsheds, etc., the following are given as the maximum dimensions of freight cars which it is safe to run west of the Missouri River; Length, 35 ft.; height from top of rail to eaves of car, 12 ft.; width, 10 ft. Cars which exceed these dimensions in any particular will not be received by the lines west of the Missouri River.

2. Agricultural implements, vehicles, furniture and similar light and bulky freight in car loads to the Pacific coast, to be entitled to the rates published in the tariff, must be loaded on or in cars whose outside dimensions will not cube to exceed 1890 ft.

3. Any excess of 1890 cubic ft. outside measurement in one car will be charged against the contents at a proportionate rate; that is each cubic foot will be estimated as weighing 10 582-1000 pounds, and charged for accordingly; provided, however, if actual weight of contents is greater than the above estimate, charges will be collected on the actual weight.

4. The above rules, limiting the maximum dimensions, and for estimating weight of contents of box cars, will be applied to platform cars and their loads.

ALBANY, Oct. 30.—The Harlem River Railroad Company was incorporated to-day, with a capital of $2,000,000. Its object is to construct a road from the junction of the New York, New Haven & Hartford and the New York & Harlem railroads in East Chester, in a southerly direction along the Harlem River to Mott Haven, eight miles.

AN ELECTRIC RAILWAY FOR MT. DESERT.—The Bangor *Whig* says that Messrs. Payson Tucker and William A. Allen, of the Maine Central Railroad, and Messrs. W. B. Hayford, C. V. Lord, T. N. Egery, F. W. Cram, F. M. Laughton, F. H. Clergue, C. F. Bragg, Sumner Laughton and F. W. Goodwin, of Bangor, have organized as the Mount Desert Railway Company, to construct a narrow gauge railway from the village of Bar Harbor, a distance of about three miles, to Eagle Lake, to connect with the steamer Wauwinet, which runs across the lake to the foot of Green Mountain Railway. A survey will at once be begun, and the Railroad Commissioners will, on Friday, hear the petitioners. It is probable, says the *Whig*, that a new method of running trains by electric power will be adopted on the road.

WEST KANSAS (Kan.) will have, in all probability, a viaduct across the Missouri Pacific yards.

NEW ROAD.—The Manitoba Southwestern will be begun at once.

THE Galveston Water Company has been organized with a capital of $500,000. The work of putting up the salt water systems is to begin in a week. The source as to the fresh water supply has not been settled yet.

THE GALVESTON HARBOR IMPROVEMENT.—Since June 30, 1880, Major Mansfield has expended $859,568, exclusive of the city appropriation of $100,000.

THE bridge for the Clark Fork of Trinity River (Tex.) has been shipped by the Smith Bridge Com

pany, of Dayton, O. The cost is between $6,000 and $7,000.

A SWEET LINE.—The Mississippi Valley road is now known as the "Sugar Line." It runs for 100 miles through the sugar district.

THE City of Mexico is putting down iron mains, and it is proposed to bring water from Molino del Rey, and do away with the masonry aqueducts.

THE DULUTH CULVERT.—There has been some trouble with the contract for the above. Mr. O'Brien, the contractor, has agreed to modify the same so as to bring the sum within $65,000.

THE sum of $150,000 has been applied for by Major Conger for the improvement of the Yellowstone Park.

THE ST. LOUIS & DAKOTA.—A conference of capitalists was recently held in St. Louis with regard to this road. The line will run from St. Louis to Jamestown on the Northern Pacific. A bridge will be built over the Missouri just west of Creve Corner Lake.

MORE bridges are wanted in Chicago. The Commissioner of Public Works has submitted an estimate of $150,000 for constructing a swinging bridge at Market street.

THE contract for the improvement of Fortieth street, Hyde Park, Ill,, has been given to Dolese & Shepard for $7,374.

THE DULUTH WATER-WORKS.—The work for the season is nearly finished.

THE Hennepin Canal will form the subject of a discussion among the representatives of Illinois and Iowa who will meet in Chicago Nov. 1.

CHICAGO PARKS.—Works are now nearly suspended.

THE bridge over the Missouri at Blair, Neb., was opened Oct. 27. It was built by the Keystone Bridge Co., of Pittsburgh. It rests on four stone piers, fifty feet above high-water mark, and is very nearly 1,000 feet long. The bridge so far has cost $800,000, one great item of expense being the work to protect the banks from the annual floods.

THE bridge over the Caney Fork River will be completed about Nov. 1.

THE Fairmount Park appropriation has been cut down almost $100,000.

APPROPRIATION for the Philadelphia Department of Surveys was discussed at the last meeting of the Finance Council and was postponed until the bill is printed.

SUSPENSION BRIDGE IN MCKEESPORT, PA.—A contract was let last week for a stiffened steel-wire cable suspension bridge about 700 ft. long and 30 ft. wide, with a middle span of 320 ft. The contractors are Gustav Lindenthal, bridge engineer, and J. Friday, both of Pittsburgh, Pa. The bridge is to be a very substantial structure, to be completed June, 1884.

THE new dredging machine, Nathan Appleton, was launched at the yards of Slaven Brothers, Petty Island, a few days ago. It is for use at the Panama Canal.

NEW Water-Works will be put up at Belton (Texas). The system has not been decided upon. $45,000 have been appropriated.

NORTHSIDE BRIDGE IN PITTSBURGH, PA.—Work has been commenced with a large force on the pier foundations for the Northside Bridge over the Allegheny River at Seventh street in Pittsburgh. It is expected to complete all three pier foundations yet before winter. The bridge will be about 1,100 ft. long and 42 ft. wide, and of same strength and rigidity as the recently completed Smithfield street bridge over the Monongahela, so as to have no restrictions on the speed of crossing teams. The plans are being prepared by G. Lindenthal, Bridge Engineer. J. Friday has the contract for all foundations and masonry.

THE International Bridge over the Rio Grande will soon be well forward. A quantity of material has arrived, and one of the principal contractors on the grading of the road has gone to New York to hasten matters.

SURVEYORS laying out the line for the railroads from Belleville (Ill.) to Centralia have finished their work as far as Baden.

S. S. GREELEY & CO., surveyors, are at present engaged in locating the dock lines of the Calumet River, south of Ninety-fifth street, South Chicago.

AN ENGINEER'S FEE.—At a meeting of the Philadelphia Council, a communication was received from Chief Engineer Ludlow, recommending a fee of $1,000 to Mr. Wilson for his work on plans for the Market street bridge.

THE WINNIPEG & HUDSON BAY.—It is proposed to memorialize the Dominion and imperial governments in regard to the building of this road.

DEPARTURE OF A SURVEYING EXPEDITION.—Mr. W. J. Glenn left El Paso lately in charge of a surveying expedition, consisting of 20 men. They took a goodly number of burros, with provisions, etc. They will be absent about two months, completing a survey of 1,000 leagues of land, in the Sierra Madre, and extending from El Paso to Corralitos. The contract for this survey has been taken by Gen. Harrison, Capt. Davis and Major Zimpleman. These gentlemen also have the contract for the survey of 1,500 leagues in the State of Durango, which is being conducted by Mr. Wingo.

WORK on the new Seventh street bridge over the Allegheny River at Pittsburgh is progressing rapidly.

THE WILMINGTON (DEL.) BRIDGE.—The contractors for the new bridge will soon begin work. The caisson is being built at the yards of Henhoffer & Vaughan.

CONNECTICUT speaks of "big" railroad schemes.

JOSEPH M. MARSHALL, contractor, of Annapolis, will build the United States Marine barracks at New Orleans.

SAN ANTONIO, Oct. 19.—Railroad construction is progressing satisfactorily in Mexico. Dave Bernard, the contractor, left to-day for the interior of Mexico with his entire outfit.

MARION (Fla.) wants a $50,000 court house.

IMPROVING BOSTON WATER.—The storage basins in Framingham and Ashland are being deepened, and a conduit 3,000 feet in length will soon be begun. It will cost $168,000.

NEW ORLEANS PROSPEROUS.—All the contractors are busy. Some builders have 50 per cent. more work than at same time last year.

THE SAN FRANCISCO WATER SUPPLY.—The Spring Valley Water Company are to build a large reservoir. There are several lakes around San Francisco, but the expense of bringing water from them is regarded as too serious.

THE WASHINGTON (D. C.) RESERVOIR contractors are greatly aggrieved over the fact that the War Department has awarded the contract to the third lowest bidder—his figures being $82,000 higher than the lowest. Secretary Lincoln said that he approved the recommendation made by the Engineer, Commissioner of the District and the Chief of the Engineer Corps of the army, which was favorable to the lowest bidder. The reason assigned for this action was that the successful bidder already had a plant worth about $50,000 and was ready to prosecute the work at short notice. Complaints, however, had been made to him concerning the manner of the award, and the subject would be thoroughly investigated before further action was taken. No bond had yet been presented to the department, and the matter is still in the hands of the Engineer Commissioner, Maj. Lydecker.

WORK ON the La Crosse, Iowa & Southwestern Road has been begun in Iowa. A bridge will be built over the Mississippi at La Crosse.

THE WILLAMETTE BRIDGE. — PORTLAND, O., Oct. 29.—To-day a very important railroad bridge question was decided by Judge Deady in the United States Circuit Court. The question was on an application made by Ellis G. Hughes for a perpetual injunction restraining the Northern Pacific Railroad, Oregon Transcontinental, Oregon Railway and Navigation Companies, and four other improvement and railway corporations from building a large bridge across the Willamette River. The application was prayed for on the ground that the structure would be a serious obstruction to navigation. The court sustained the demurrer to the application and dismissed the bill. It was held by Deady that the law authorizing the Northern Pacific Railroad Company to build a railroad from Lake Superior to Portland necessarily authorizes the construction of a bridge, subject of course to judgment of a competent court as to the exact site and nature of the structure affecting the question of its special and general damage to navigation.

IRON, METAL AND COAL MARKET.

PHILADELPHIA, NOV. 1.

There is a slightly improved feeling in the pig-iron market, owing to the moving of some large lots of inferior irons, which has, to a certain extent, relieved the market, and to the increased volume of inquiry received within the past few days. No. 1 Foundry is selling in small lots for current requirements at $20.50 @$21; No. 2, at $18.50@$19.50, and Gray Forge at $18.50@$19, delivered for standard brands, while inferior grades sell considerably lower. There are numerous very low offers now in hand, and some of these will probably lead to large transactions in a week or two. Foreign irons are very dull, and no sales are to be reported. Scotch iron is arriving in moderate quantities, and going into consumption. Bessemer is offered at $2.50, and Spiegeleisen at $30.50 for 20 per cent. Muck Bars are dull at $33.50@$34. Steel Rails are believed to have sold in large lots at $36.50, for delivery in Pittsburgh, but makers are very reticent as to the nature of the business done. Negotiations are said to be under way for about 50,000 tons, and it is certain that that amount could be sold in a very short time, if buyers' offers were accepted; but no sales have been heard of under $36, although there are offers at less. Small lots continue to move as usual, at $36.50@$37.50. Old Rails are nominal at $23.50 asked for Tees, foreign, and $24.50 for American; $25.50 is asked for Double-heads, but buyers refuse to purchase at that price. Plate, Tank and Structural Iron are active and firm; mills are well supplied with orders for a few weeks, and there are large requirements for engineering and other purposes, which, it is expected, will keep the full capacity engaged through the winter. Quotations 2.35@2.40c. for Plate and Angles, 2.75@3c. for Tees, and 3.50c. for Beams and Channels, with prices for Shell, Flange and Fire-box unchanged. Nails, $2.80@$2.90, with a fair movement of car-load and smaller lots. There is an active demand for Best Scrap at $24.50@$25. Other kinds dull.

PITTSBURGH.

The Pittsburgh iron market is in an unsatisfactory condition, and there is no prospect for any better state of thinsg for some time to come. Steel rails have improved slightly in demand, and several heavy orders for delivery in the spring have been placed at $37; small lots and lots for near-by delivery are still quoted at $38@$38.50. Merchant iron is in dull demand for future requirements, but small sales are being made for current needs at 1.80@2c. Some large sales are reported to have been made at 1.70c. Mills are running short of orders, and the outlook is very discouraging. Pig iron is as dull as it was ever known to be, and only small lots can be moved at $20@$21, time, for No. 1; $18@$20 for No. 2, and $17.50@$18 for Gray Forge. Some fair sales of Bessemer have been made at $21@$21.50; Old Rails, $23.50@$24.50; Muck Bar, $32@$34; Nails, $2.70@$2.80. The suspension in the nail mills has been again postponed, as the stocks are light

CHICAGO.

There has been an active inquiry for bar iron through the past week, but the trade is quiet, and shows some falling off, as buyers are demanding heavy concessions, which makers refuse to grant. Orders are being filled at $2@$2.10, with concessions from these prices on large lots. Quotations for Tank are 2.70@2.80c.; for Angles, 2.80@3.00c., and 3.60c. for large lots of Beams, with from 10@15c. more for small lots; 3.80c. is paid for small lots of Channels, with shadings for large orders. H. No. 1 Flange, 4.75, and Shell, 3.75. Heavy sheet iron is very dull. Galvanized sells at 45, and 5 off for Juniata, and 45 and 10 off for Refined. Norway and Swedish irons are active, and the supply is large. Russian iron is active and firm. Nails are quiet and weak at $2.90@$3. Scrap iron is moderately active for all kinds at $17.50 per net ton for No. 1 Wrought; Wrought-Iron Turnings, $9; Cast-Iron Borings, $6.50; Malleable Scrap, $5. Steel Rails are quoted at $40; there is no change in the market, which has been dull for a long time. Pig iron is fairly active. Southern irons are holding their own, their low price keeping them in favor. The hardware trade is rather less active than last week, as builders' goods are in no demand except for immediate requirements, and other kinds are quiet.

COAL.

The coal trade is a trifle less active this week than last, owing to the absence of that manufacturing demand which is usually presented at this season, as well as to the slight falling off in demand from New England, and the scarcity of freights. But heavy shipments continue to be made to the West and South, and the output continues to increase week by week. The long-talked-of restriction of production has not yet been settled, and the larger operators here seem confident that the heavy demand from the West will make this policy unnecessary. The pressure for restriction comes almost altogether from New York, where stocks accumulate more rapidly than here. The Philadelphia operators are well sold ahead, and feel certain that they can market their entire production up to the three-quarter time of winter; but for the sake of harmony, they will agree to a slight restriction, should it become necessary. The production of anthracite coal for the week ending Oct. 20 was 757,318 tons, as against 690,515 tons for same week last year; total production for year to same date, 24,930,154 tons, or an increase of 2,209,687 tons over last year. The Reading Company carried, for week ending Oct. 27, 314,000 tons. This company continues to make very heavy shipments to the West.

The Pennsylvania carried, for last week reported, 275,541 tons of coal and coke, and for year to same date, 7,177,495 tons coal and 2,495,385 tons of coke.

Stocks at Port Richmond are 60,000 tons. Freights are scarce, on account of the unfavorable weather, which has held vessels back, and rates to Boston are $1.20@$1.30.

The bituminous production for week last reported was 104,917 tons, sent to Eastern markets. Total production to date, 3,976,131 tons. The bituminous trade is dull and prices are weak, owing to the heavy production and active competition.